

SCIENCE.

FRIDAY, JUNE 13, 1884.

COMMENT AND CRITICISM.

RARELY have all the conditions for abounding physical research been so admirably met; rarely has one so fortunate as to be in absolute command of such circumstances been removed in the very prime of life: but still more rarely has the unfinished work of a scientific man, called away under these relations, — only making the fate more inexorable, and the loss more sad, — fallen into hands so competent and appreciative as those of the late Dr. Henry Draper. His work on astronomical spectrum-photography has, since his lamented death in 1882, been reduced and discussed by Professor Young of Princeton, and Professor Pickering of Cambridge, and recently published in the Proceedings of the American academy of arts and sciences. We present in another column a notice of these researches, and may recall, in this connection, the second issue of *Science*, wherein the points of chief interest in the life of Dr. Draper, and the character, in outline, of the more important of his researches, were concisely dealt with. Notwithstanding his fondness for writing, the original published papers of Dr. Draper number only about a score; but many of them represent months, and in some cases years, of consecutive investigation. Had he been spared but a few years more, there can be little doubt that the world of science would, as has been said by one who knew him most intimately, have been enriched with a wealth of discovery almost unparalleled. The calamity of his death has been to some extent mitigated by the painstaking study of his spectrographic work which Professors Young and Pickering have made; Dr. Draper's method as an investigator being such that his death has rendered it possible for his co-workers to derive these results substantially as he would have done himself. To all scientific men en-

gaged in original investigation, however, his sudden death must constitute a potent reminder of the desirability of publication proceeding almost simultaneously with research itself.

THE imminent danger of extinction which threatens many of the rare plants of the Swiss Alps has led to the formation of a society for their preservation. On reading the account of this society, presented in another column, the question naturally arises, Are any of *our* rarer species likewise in danger of extermination? With the exception of the extensive raids which are annually made upon some of our native plants by herb-collectors (and it must be understood that this business has assumed very considerable proportions, especially at the South), there are no very large drafts made which imperil the existence of the less common species. To be sure, in a few localities the mayflower and the climbing fern have been extirpated by the greed of collectors for the market; but it can hardly be said that these beautiful species are yet in peril. The same is true of the medicinal plants, ginseng and mandrake. It is fortunate that most species collected for medicinal purposes are reasonably prolific, and will doubtless hold out until those now in fashion have been discarded by other aspirants for popular and professional favor.

Nor are our rarer mountain-plants in any immediate peril. Those who have observed the difficulty apparently experienced by the attendants in White-Mountain hotels, in working up a 'boom' in dried plants, feel little apprehension that the localities will become exhausted. And it should further be noted, that our botanists who collect for exchange are generally very prudent in their use of the rarer species. There is, however, some danger lest the interesting localities where species are found somewhat out of place, so to speak. —

such, for instance, as magnolia at Gloucester, and great rose-bay at Sebago, — may be stripped of their treasures. These 'late-lingers' possess great interest, and they should long be carefully guarded. But, so far as our rare plants in general are concerned, we do not yet need any society for their preservation: we do, however, need many local societies for their detection, and for critical study of their habits.

A YEAR ago five commissioners of state water-supply were appointed by the New-Jersey legislature to select the best practicable plans for supplying the cities and towns of the state with pure and wholesome water. A report has recently been presented by them to the governor, on the capabilities of the Passaic-River basin for the collection and storage of water for the several centres of population that must now, or in the near future, depend upon it; and a plan elaborated by Mr. L. B. Ward, hydraulic engineer, is appended for the supply of Jersey City, Newark, and other neighboring municipalities. According to this plan, the waters of the Pequannock, a tributary of the Passaic, can furnish sixty million gallons daily, at an expense of two million dollars. With a further cost of three hundred thousand dollars, the supply can be increased to eighty million gallons, sufficient for all probable requirements for twenty years to come. Farther in the future, the Wanaque and Ramapo watersheds can yield an additional two hundred million gallons daily, so as to serve a population of two million eight hundred thousand souls. The chief danger of pollution in the Pequannock valley is of a modern kind: it comes from leakage of the Oil transit company's pipes that carry petroleum from the oil-wells of Pennsylvania to Jersey City; but this danger can be averted by state enactment. Mr. Ward's report contains a well-prepared contour-line map of the Pequannock basin, with darker and darker tints for every elevation of one hundred feet: this is reproduced from a more extended map, based on 'the valuable contoured maps of the New-Jersey geological survey,' and on special sur-

veys by the commission in the adjacent part of New York. In view of the rapid growth of many of our cities, and of the increasing recognition of the value of a good water-supply, this fore-thoughtful action of the New-Jersey legislature should be imitated in other states.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Professor Tait on the reality of force.

THE arguments by which Professor Tait seeks to disprove the objective reality of force, and to justify his advocacy of the exclusion of the term from scientific writing, occupy two and a half pages at the end of a seventy-four page article on mechanics, in the last edition of the Encyclopædia Britannica. The vigor and confidence with which they are there stated, notwithstanding the author's treatment of forces as real entities in the body of the article, the character of the publication in which they appear, and the eminence of the Edinburgh professor in mathematics and physics, make them worthy of a careful examination.

In the first place, Professor Tait infers that force can have no such reality as matter has, because it is to be reckoned positively and negatively, — an action being opposed by a reaction, — while matter, or mass, is signless. This suggests two comments: 1°. The author never questions the objective reality of space and time, of which realities it is an essential feature, that, to every direction or interval $A-B$, an equal direction or interval $B-A$, of opposite sign, corresponds; 2°. The idea of a negative mass is not a self-contradictory one, and was once widely accepted. The element phlogiston was given up, not because of any absurdity in ascribing levity to material substance, but because a form of matter with positive mass (oxygen), capable of explaining all the phenomena, had been actually separated and identified.

Professor Tait's next criterion of objective reality is quantitative indestructibility, — an attribute shared by time, space, and matter, to which he adds energy. But the evidence of the indestructibility of energy is not of the same nature as that of the indestructibility of matter: for the latter, in all its forms, may be localized, and its density or elasticity measured; while the former, when stored up or 'potential,' cannot be shown to possess a single one of the properties of energy kinetic, or any existence in space, or any objective character whatever. Professor Tait virtually admits this difficulty, and awaits for its solution the discovery of some evidence 'as yet unexplained, or rather unimagined.' All strains and other actions of a clock-weight on its supports are obviously precisely the same — or impalpably somewhat stronger — with the weight wound up an inch as with it wound up a yard; and the existence of a greater 'potential energy' in the latter case is not to be found in the clock, but in the mind, which requires this expression as a form in which to put its conviction that a certain greater amount of work can be obtained. Even though it be admitted that there are no other intelligible terms in which this conviction can be stated, it is clear that the indestructibility of energy is an ideal and subjective truth, and cannot, therefore, be relied on as evidence of a reality distinctively 'objective.'

A third point made by Professor Tait against force is, that its numerical expression is that of two ratios, — the 'space-rate of the transformation of energy,' and the 'time-rate of the generation of momentum.' These results are obtained by simple division, in an equation which expresses the fact that the work done by a body in falling the distance h is just that required to lift it through h against gravity. The fallacy involved in treating the numerical expression for force as force itself has been well exposed by Mr. W. R. Browne, in a criticism of this encyclopaedia article (*Phil. mag.*, November, 1883); and the assumption that ratios are necessarily non-existent is even more fallacious. Were it trustworthy, Professor Tait's equations would lead quite as conclusively to proofs of the non-objectivity of space and time (the former becoming the rate of work-units, the latter of motion-units, per unit of force), and so to a confirmation of the celebrated German view that whatever is universal and necessary in thought belongs to the subject, as to what he deduces from them; or they might even give mass in the form of a ratio, and hence suggest the non-objectivity of matter.

Not the least of the professor's objections against force, it would appear, is that it is 'sense-suggested.' It is a mere truism to say that no other suggestor is possible within the domain of science. It is, perhaps, better worth while to call attention to the indubitable fact that the real ground of the objection against 'action at a distance,' entertained by many physicists, is exactly that such action is not directly suggested by sense-impressions: for this is what they must really mean by calling it 'occult'; actions as our consciousness knows them, and as we can produce them, being generally characterized by proximity undistinguishable from actual contact. Further, if there is any reproach in this epithet, energy is quite as open to it as any function of energy can be: in fact, our senses directly report work in the form of nerve-disturbance, and nothing else. Force is no more truly an inference from nerve-reports testifying of energy exerted, than is matter: in fact, the inference of the independent existence of matter is the less direct and more questionable of the two. The view advocated by Mr. Browne, following Boscovitch, that matter is but 'an assemblage of central forces, which vary with distance, and not with time,' or with direction, is one of great simplicity, as well as suitability to analytic treatment, and one of which no disproof is possible.

It is not too much to claim, therefore, that, in the very difficult task of proving or disproving objective reality, Professor Tait has not here been successful.

HENRY FARQUHAR.

North-eastern and north-western Indian implements.

I do not see that it necessarily follows, because such implements as I have described as 'club-heads' were or are in use among the Ojibwas as 'bone-breakers,' that the Lenni Lenape used these pebbles for such a purpose, and not in the manner I have suggested. It would naturally be inferred from Miss Babbitt's remarks, that the Dakota puk-gah-mah-gun never varied in its size or shape. If so, then probably no weapons of this pattern have occurred in New Jersey; but this is not true of any form of weapon, agricultural or household implement, ever made by the Indians. They vary indefinitely in size, shape, and degree of finish; and the many forms merge imperceptibly one into the other, as axes into hammers, knives into spears, and these again into

arrow-heads. Miss Babbitt herself distinctly states that the two forms of 'club-head' and 'bone-breaker' are essentially the same. If the specimen I figured (fig. 212) in my 'Ancient stone implements of eastern North America' be not a club-head, it does not follow that the more nearly globular fig. 211 was not; and I am glad to be able to state that I have seen just such grooved, globular stones mounted in wooden and hide handles, that were, until very recently, in use by Sioux Indians.

I am very glad that Miss Babbitt has pointed out the use of a large number of these oval, grooved pebbles as 'bone-breakers.' It is a most desirable addition to our knowledge of the archeology of the Atlantic-coast states; and it is now possible to grade and classify this simple pattern of stone implements much more satisfactorily. Of such found in New Jersey, I would say, then, that they are, first, grooved hammers, or mauls; second, club-heads (Dakota, puk-gah-mah-gun); third, 'bone-breakers'; fourth, net-weights.

I suggest this division as based upon the size, the degree of finish, the evidence of use (as in the 'bone-breakers'), and, lastly, the conditions under which many are found. If the flat, discoidal pebbles with side-notches are net-weights, and of this there can scarcely be a doubt, then the smallest of the grooved pebbles, which we usually found associated with them, were doubtless put to the same use.

CHARLES C. ABBOTT.

May 18.

Atmospheric waves from Krakatoa.

Mr. H. M. Paul is, doubtless, perfectly correct in insisting (*Science*, ii. 531) that the atmospheric waves following the Krakatoa explosion should not be confounded with the elastic waves producing sound: in fact, these latter are so brief that it is very questionable whether they would show themselves at all on barometric traces. There would not be time enough for the mercurial barometric column to respond to the momentary compressions and rarefactions: much less would they be indicated by fluctuations extending over thirty minutes or more. The atmospheric waves which encircled the earth, and disturbed the self-registering barometric traces on the 27th of August, 1883, must therefore have been huge aerial gravity-waves, due to the enormous displacement of air produced by the ejection of vast volumes of gaseous products into the atmosphere at the time of this volcanic explosion: they were analogous to the great earthquake water-waves that are sometimes transmitted thousands of miles across oceans.

The point in this connection which needs elucidation is the fact, established by the observations of Gen. Strachey, Professor Förster, and others, that the velocity of these waves was approximately the same as that of an elastic sound-wave in air. It is the near coincidence of these velocities which has led to the confounding of these gravity-waves with elastic sound-waves. The approximate identity of the velocities in these two cases may be traced to the relation existing between the elasticity or resilience of the air, on which the velocity of sound depends, and the height of a homogeneous atmosphere, on which the velocity of long aerial gravity-waves depends.

It is well known that the mathematical investigations of Sir G. B. Airy and others, confirmed by the experimental results of Scott Russell, show, that, in the class of water-waves in which the wave-length bears a large ratio to the mean depth of the water, the velocity of propagation of the wave is sensibly

equal to the velocity acquired by a heavy body in falling vertically *in vacuo*, under the action of gravity, through half the mean depth of the water. Now, it is highly probable, that, notwithstanding the variable density of the atmosphere with altitude above the surface of the earth, the same formula is applicable to long gravity-waves propagated in it; viz., that the velocity of the wave is equal to that which a heavy body would acquire in falling vertically through half the height of a homogeneous atmosphere.

It is likewise well known, that the illustrious Newton (*Principia*, book ii. prop. 49), neglecting the influence of the thermal changes incident to the propagation of aerial elastic waves, deduced a most remarkable but imperfect formula for the velocity of sound in air, making it equal to that which a heavy body would acquire in falling vertically through half the height of a homogeneous atmosphere whose weight or pressure measures its elasticity.

It will be noticed that the velocity of sound by Newton's formula is precisely the same as that given by the hydrodynamical formula for long aerial gravity-waves. It is true, that, in consequence of the heat momentarily developed or absorbed during the condensations and rarefactions of the air, the actual velocity of sound exceeds that computed by the Newtonian formula by about one-sixth (a correction of the formula supplied by Laplace); yet the approximation is sufficient to seemingly co-ordinate the velocities of these diverse kinds of aerial waves.

Thus, the height of a homogeneous atmosphere, under standard conditions, being 7,990 metres, the velocity of sound computed by the Newtonian formula equals 279.96 metres per second at 0° C., and 293.5 metres per second at the August temperature of 27° C. The actual velocity of sound at above-indicated temperatures equals 332.5 and 348.6 metres per second respectively.

On the other hand, the following are some of the estimates that have been made of the velocity of the Krakatoa atmospheric waves:—

		Velocity in metres per second.
Gen. Strachey	in England	301.3 to 315.0
Professor Förster	at Berlin	278.0
Mr. Renou	at Paris	246.0 to 278.0
Mr. Renou	in France	305.0 to 319.0
Mr. Wolf	at Paris	325.8
Mr. Baillaud	at Toulouse	324.0
Mr. Hall	at Jamaica	308.5

All of these estimates fall decidedly short (as theory indicates) of the actual velocity of sound in air; and most of them approximate somewhat more nearly to the velocity computed by the Newtonian formula, which, as we have seen, corresponds with the hydrodynamical formula for long aerial gravity-waves.

Considering the inherent difficulties of the precise determination of the several data requisite for deducing the true velocity of the atmospheric waves originating at Krakatoa on this occasion, we need not be astonished at the considerable divergence in the estimates, or that the assumed exact coincidence of velocities of the two kinds of aerial waves fails to be verified in an accurate manner, either by theory or by observation.

JOHN LECONTE.

Berkeley, Cal., May 15.

A near view of Krakatoa in eruption.

In connection with the remarkable atmospheric wave, which, starting from Krakatoa at the time of the eruption, "travelled no less than three and a

quarter times round the whole circumference of the earth,"¹ the following extracts from the log of a vessel sailing in the close vicinity of Krakatoa may be of interest:—

Extracts from log of barque William H. Besse, from Batavia towards Boston.

Aug. 26.—This day commences with light airs and calms. Light airs throughout the day. At 5.30 p.m., wind hauling ahead, let go starboard anchor with thirty fathoms chain, clewed up and furled all sail. Adam light bore W. 1-4 S. and E. by S. Throughout the afternoon and night, heard heavy reports, like the discharge of heavy artillery, sounding in the direction of Java Island. Very dark and cloudy throughout the night, with continual flashes of lightning. Barometer 30.15.

Aug. 27.—Commences with strong breezes, and thick, cloudy weather. Barometer 30.12. At 9.30 a.m., pilot left ship. Hove the lead every fifteen minutes. At daylight noticed a heavy bank to the westward, which continued to rise; and, the sun becoming obscured, it commenced to grow dark. The barometer fell suddenly to 29.50, and suddenly rose to 30.60. Called all hands, furled every thing securely, and let go the port anchor with all the chain in the locker. By this time the squall struck us with terrific force, and we let go starboard anchor with eighty fathoms chain. With the squall came a heavy shower of sand and ashes, and it had become by this time darker than the darkest night. *The barometer continued to rise and fall an inch at a time.* The wind was blowing a hurricane, but the water kept very smooth. A heavy rumbling, with reports like thunder, was heard continually; and the sky was lit up with fork lightning running in all directions, while a strong smell of sulphur pervaded the air, making it difficult to breathe. Altogether, it formed one of the wildest and most awful scenes imaginable.

The tide was setting strong to the westward throughout the gale, at the rate of ten knots per hour. At 3 p.m. the sky commenced to grow lighter, although the ashes continued to fall. The barometer rose to 30.30, and dropped gradually to 30.14, when it became stationary. The whole ship, rigging and masts, were covered with sand and ashes to the depth of several inches.

Aug. 28.—Commences with light airs, and thick, smoky weather. Hove up starboard anchor, and hove short on port anchor. Dead calm throughout the day and night. Saw large quantities of trees and dead fishes floating by with the tide; the water having a whitish appearance, and covered with ashes. This day ends with a dead calm, and thick, smoky weather.

Aug. 29.—This day commences with calms, and thick, smoky weather. Made all sail throughout the day. Moderate winds, and thick, smoky weather. Passed large quantities of driftwood, cocoanuts, and dead fishes. At 8 p.m., passed Anjer,² and could see no light in the lighthouse, and no signs of life on shore. Furled all light sails, and stood under easy sail throughout the night. Day ends with moderate winds and cloudy weather. Barometer 30.14.

Aug. 30.—Commences with moderate winds and cloudy weather. At daylight made all sail with a fresh breeze from the westward. Found the water for miles filled with large trees and driftwood, it being almost impossible to steer clear of them. Also passed large numbers of dead bodies and fish. Kept a sharp lookout on the forecandle throughout the day.

¹ *Nature*, vol. xxx. p. 12.

² All except the foundation of the lighthouse was destroyed by the tidal wave.

At 10 A.M., sighted Java Head lighthouse; but the wind hauling ahead, we kept away, and went round Prince Island. Latter part, fresh breezes, and thick, smoky weather. Friday and Saturday, passed large quantities of ashes in the water. Saturday, crew employed in cleaning ashes off masts and rigging. Water had a green color.

The point of special importance in the above account is the record of the sudden barometric fluctuations, due to the great air-wave with which readers of *Science* are already familiar.

Accompanying the above extracts from the log, is a sample of the 'sand and ashes' which fell so thickly upon the rigging. It is of a light gray color, and harsh to the touch. It is essentially a pulverized pumice, by far the greater part of it consisting of fragments of volcanic glass. These fragments are sometimes twisted, but generally in flat, angular transparent scales, which are filled with minute bubbles, and, of course, are isotropic. Angular fragments and crystals of transparent plagioclase, occasionally showing the hemitropic striations, and giving bright colors in the polariscope, together with more irregular and rounded fragments of dark green and brown pyroxenic minerals, probably augite and hypersthene, are scattered very occasionally among the glass particles. Grains of magnetite, often well rounded, also occur, and may be picked out and examined separately by a magnet covered with tissue-paper.

The dust collected by Mr. Joseph Wharton, from snow which fell in the suburbs of Philadelphia on Jan. 22, and supposed by him to be of volcanic origin,¹ has been kindly submitted by him to the writer for examination. It is composed of particles of quartz, coal, cinders, vegetable matter, etc., among which are certain glassy hairs and rounded globules. These bear no resemblance to the angular glass fragments composing the Krakatoa dust, which is remarkably free from either filaments or globules; and the supposed volcanic glass particles in the Philadelphia dust appear to be of local origin, — from blast-furnaces, foundries, or the like.

For the vial of dust, and the extracts from the log, I am indebted to my friend, Rev. Wayland Hoyt, D.D., of this city.

H. CARVILL LEWIS.

Philadelphia, May 27.

Professor Gill on assumptions of museum-keepers.

In a recent issue of *Science*, p. 615, my friend Professor Gill has made a rather savage attack upon another very good friend of mine, for which I feel in some degree responsible, since a remark in my review of the 'Voyage of the Challenger' has been taken by the former as a text for his philippic. I have no desire to cross swords in argument with so skilful a dialectician as Professor Gill, and shall therefore be contented to make certain general statements.

1. The policy of Dr. Günther, as keeper of the zoölogical collections of the British museum, has, from the start, been an extremely liberal one, much more so than that of his predecessor. I know of no museum where facilities are more readily granted, the methods in the natural-history department and in the great library of the British museum being precisely similar. Any person known to the authorities may secure the use of a table in one of the laboratories, and may have specimens brought to him day after day, from morning till night, as fast as he can fill up and sign the requisitions. That this is so, I can testify from personal knowledge. Within the past eighteen months, I have known of seven ichthyologists, —

three from the United States, one from Italy, one from France, one from Sweden, and one from Australia, — each of whom spent weeks in the museum, and had no specimens refused him. I have also known of several other American zoölogists who have been treated with equal courtesy. I may mention, in passing, that no person, not an officer of the museum, is ever allowed to work in a room by himself, no matter how well he may be known, — a precaution which I believe to be quite necessary, since privileges of this sort have in the past been shamefully abused. I might mention one instance, many years ago, in which the entire collection of alcoholic specimens in one group of vertebrates was badly mutilated by a series of coarse dissections, carried on, without the knowledge of the authorities, by a young student, now one of our most distinguished American zoölogists. I have heard the story from his own lips, as well as from Dr. Günther.

2. The Challenger fishes are not, as yet, turned over to the British museum, but are still under the control of the lords of the admiralty, by whom, through Sir Wyville Thompson, Dr. Günther was requested to prepare the report upon the ichthyology of the expedition. Dr. Günther, therefore, in my opinion, is perfectly right in retaining this collection under his own control until his report is completed, after which they will, no doubt, become the property of the British museum, and be open to inspection under museum rules. The distinction between Dr. Günther in the capacity of keeper of the zoölogical collections of the British museum, and Dr. Günther in the capacity of naturalist, engaged upon the Challenger report, should be carefully observed.

Professor Gill refers to a case in which a certain European ichthyologist has recently been refused the privilege of examining the Challenger collections. Not being in possession of all the facts in the case, I shall not attempt to explain it. This I do know, however, that, at the time referred to, the Challenger fishes were being moved, together with the natural-history collections of the British museum, from Bloomsbury to South Kensington, and were in large part packed in boxes, so that they were really inaccessible; but a portion of the collection was still upon a table in Dr. Günther's private office: and these specimens, as well as others in his own house, were freely shown by him to Dr. Bean and myself. I cannot doubt that the same privilege would have been extended to any other ichthyologist who had made any reasonable request for the use of the material. It should be remembered, however, that these collections were not worked up in any way, were neither catalogued nor labelled, and were held by Dr. Günther as a personal trust from the Challenger survey, and had not yet passed into his official custody.

The question as to the extent to which any specialist, charged with the duty of working up collections made by a government expedition, may reserve to himself, while engaged in the preparation of his report, the handling of the material, is one into which I do not wish to enter at present. Professor Gill is apparently of the opinion that some question of moral principle is involved, and that working naturalists should be communists in respect to the use of material. The only point which I desire at present to make is this, that Professor Gill has evidently been misinformed as to the manner in which Dr. Günther has administered his trust as custodian of the zoölogical collections in the British museum.

In conclusion, I desire to enter a serious protest against the bitter and unreasonable criticisms upon Dr. Günther's work which have of late years so fre-

¹ *Science*, Feb. 1, 1884, p. 139.

quently appeared in American journals. Criticism which ignores all that is good, and exaggerates all that is imperfect, in the work of any specialist, especially in that of so eminent a master as Dr. Günther, is greatly to be deprecated. G. BROWN GOODE.

Washington, June 1.

'A singular optical phenomenon.'

With reference to the 'optical illusion' to which your correspondent 'F. J. S.' drew attention (*Science*, No. 57, p. 275), and which has been abundantly illustrated and explained in later numbers, may I suggest to your readers who have not yet witnessed the phenomenon, to beg, borrow, or buy a few square inches of that finely perforated card which ladies were accustomed to use a good deal for working book-markers, initials, and the like.

There are several ways of using it with good effect. 1°. Before cutting the sheet, use it with a hand-mirror, standing (a) with the back to the light, and looking *through* both the real and the reflected cards; (b) facing the light, and looking *through* the one, *at* the other. 2°. Cut off a strip if the quantity available is restricted: otherwise divide in two more equal portions, and holding the smaller in one hand, between the eye and the larger, vary the distances absolutely and relatively, and also the relative inclinations (in their proper parallel planes); in this case, also, varying the position with respect to the light. 3°. Use the same close to a strong light, in such a way that the first surface (and the fourth) shall be in shade, while the second, and more especially the third, shall be in strong light.

The variations possible are, of course, far too numerous to admit of categorical statements. Still less can I attempt to describe what is seen. Nor, indeed, would it be a sensible proceeding to describe what is at once so easy, and so very much more interesting to see. My object is merely to point out the means and the manner.

I will, however, mention two of the more curious aspects presented. 1°. When a luminous background is seen through the reflected screen, and the latter is moved freely about in its own plane (which, of course, is supposed parallel to the glass), the phantom screen remains *stationary*. 2°. When one screen is held at arm's length, and the other two or three inches nearer to the eye, so as to produce a phantom some three or four times the size of the real pattern, the circumstances are favorable for concentrating attention on the contrast of colors presented. What I see is a sharply-defined rectangular network, as of blue steel wires with secondary and tertiary nets of doubtful color and indistinct form. As the intermediate screen is brought nearer to the eye, up to halfway, the intensity of color of the blue netting is much increased. I cannot pretend to give an exact indication, as I have only made a sort of hasty reconnaissance of this field. I notice, however, that the phenomenon presented by *inclining* the axes of the patterns to each other produces a wonderfully kaleidoscopic appearance.

To pursue the experiments, I should wish to use different patterns of perforation, and differently colored lights.

J. HERSCHEL.

23 Suffolk Street, Pall Mall East,
London.

Guyot's 'Creation.'

In the notice of Guyot's 'Creation' there is an error which makes me say precisely the opposite of my meaning. On p. 601, first column, fifth line, for 'only' read '*more than*.'

WRITER OF THE NOTICE.

PRESIDENT ELIOT ON A LIBERAL EDUCATION.

PRESIDENT ELIOT's address before the Johns Hopkins university in February last, which appears in the *June Century*, though radical from one point of view, is not so from another. In maintaining that Greek should no longer be an indispensable requisite to the bachelor's degree, he takes what the conservative educators must regard as very radical ground. But when we examine what he would substitute for Greek, and what studies he regards as affording the most profitable culture, we see that he does not take the same view as the advocates of scientific education. The studies which he would elevate as at least co-equal with Greek, are the English language and literature, the French and German languages, history, political economy, and natural science. A careful examination will show that this proposed change would not be the substitution of a scientific for a literary culture, but rather the contrary. The leading studies in literature are now Greek and Latin; the modern languages, literature and history, being confessedly taught in a comparatively imperfect way. By adding history and the three modern languages to the curriculum from which the student makes his choice, a very large addition is made to the literary side of the banquet. This addition is hardly compensated by the increased consideration which he would give to political economy and natural science.

While it seems, therefore, that we can hardly regard President Eliot as a pronounced partisan of a scientific education, it must be admitted that the ground taken by those who are such partisans is not very definite. Their stereotyped complaint is that too much attention is given to languages and mathematics. Scientific studies are thus placed in contradiction to those two subjects. Now, comparing our own education with that of other countries, it can hardly be claimed that we pay disproportionate attention to either mathematics or languages in this country. Not only is our mathematical education far behind that of France and Germany, but a much better mathematical training than our average student gets is absolutely necessary to an adequate comprehension of modern physical science. To take an example: it is safe to say that the number of our college graduates who know mathematics enough to understand clearly what physicists mean by the terms 'conservation' and 'transformation of energy,' is very small. One fact well worthy of consideration on both sides is, that, notwithstanding that the Germans

are among the foremost in scientific research, they are also far ahead of us in the thoroughness with which they learn the modern languages and mathematics. It is probably safe to say, that the average doctor of philosophy who has just graduated from a German university speaks and understands both French and English better than nine-tenths of American masters of arts speak or understand either French or German; that he reads Greek equally well with his American compeer, and Latin a great deal better; he also has as good command of mathematics as the best half of the American graduates, and possibly as good a command as the average American professor of our three hundred colleges. It would seem, therefore, that the whole story is not told, when it is claimed that the two studies alluded to, receive a disproportionate share of attention.

President Eliot does not define very fully what he includes under the head of natural science; but as he would give no more attention than at present to mathematics, and as such attention is absolutely necessary to any improvement in our general understanding of a physical science, we may assume that he refers principally to the biological sciences, especially botany, zoölogy, and animal and vegetable physiology. The advocates of a scientific education will probably reply, that it depends altogether on the way in which natural science is taught, whether it should take a more prominent place in the curriculum. If the teaching is confined to the regular routine of the past, and is to terminate in the ability of the student to name and describe the plants and animals which he may meet with in his rambles, a very little will suffice, though that little may be important.

With this great addition to the curriculum, it is evident that no one student can master the whole, or any considerable portion of the whole. The president of Harvard is well known as an advocate for the optional character of studies: in fact, he would permit option much earlier than it is now permitted. Yet as he would require, as a condition of admission to colleges, a proficiency in three out of the four languages, — French, German, Latin, and Greek, — he would, perhaps, not go so far in this direction as one might suppose from the general tenor of his discourse. In fact, from what he had just said of the extremely imperfect character of the knowledge which a student can possibly get of Greek and Latin in the usual course, — of metaphysics from a single text-book of moderate size, of physics from a manual of a few hundred pages, of

political economy from a single short treatise, — it would be inferred that he considers such imperfect knowledge as not worth acquiring. However this may be, it is certain, that, in permitting a student to choose from the beginning that subject for which he has the most capacity, President Eliot gives expression to a very popular view of the subject; but there is something to be said on the other side. One of the great objects of a liberal education is to secure community and sympathy of thought and feeling among the great body of educated men. If, now, among these men, are found very different natural aptitudes for special studies, it is clear that the end will be best reached by adopting a system of training for every man in that class of subjects for which his natural capacity is the weakest. If, as the writer suspects, the actual differences of capacity are not so great as the apparent differences in facility of acquisition on the current system, and if the apparent lack of talent among students in special subjects arises principally from those subjects not being presented to them in the way in which their minds are best able to grasp them, we may entertain a reasonable hope of coming nearer a common system of culture by suiting the method of teaching to the pupil.

The writer does not think that President Eliot squarely hits the point, when he indicates a preference for a thorough study of some one subject over what he considers an imperfect knowledge of a number of subjects. Properly speaking, a thorough knowledge of any one subject belongs to a professional, and not to a liberal education. The author can do little more than repeat, what he has probably said more than once before, that the main object of a liberal education should not be minuteness of knowledge, but a thorough understanding and mastery of those elementary ideas which form the foundation of all knowledge. If any system of training can be discovered which will enable the student to see the economical fallacies to which all men seem to be liable, on the subjects of the currency, the employment of labor, and the protection of home industry, as plainly as he sees the same fallacies when applied to his own every-day work, then that system would have the highest claims upon us, as supplying what was wanted to form a liberal education. The text-books adapted to such a system would be small; but they would have to be supplemented by a large amount of work, on the part of the living teacher, of a different kind from that commonly expected of him in this country.

S. NEWCOMB.

THE MIDDLE YUKON.¹—II.

WHEN we were nearly ready to start, on the morning of the 17th, we found four Ayan Indians, in as many canoes, at our camp, from the Kah-tung village above, they having left it shortly after we had, and camped just above us on the river for the night. They were going down the river some two hundred to three hundred miles, to a white trader's, and we kept passing each other for the next three or four days. I found the floating of the raft, carefully kept in the current for from twelve to fourteen hours each day, with no detentions, fully equalled the average day's journeys of the canoes, which were in the water but seven or eight hours a day; their occupants stopping to hunt every animal that was seen, and to cook a midday lunch. In fact, my Indians that traded among them more than hinted that they were hurrying in order to go along with us.

I should have stated, that on the 16th we had a number of disagreeable thunder-showers in the afternoon; their rarity on this river making them interesting to note. The Ayans that met us on the morning of the 17th had with them the carcass of a black bear, which they offered us for sale: and on buying one hindquarter, all that we could use, they offered us the rest as a present; which offer being accepted only as far as the other hindquarter, the rest was left by them on the gravel-beach, which was explained by the fact that all four of these were medicine-men, and as such they never partook of bear-meat. They told us that it was the bear we had seen the day before.

The morning of the 17th, and, in fact, intervals during the day, were characterized by a heavy fog, not quite reaching the river-bottom, but cutting the hills at an altitude of from three hundred to four hundred feet above the level of the stream. It gave the country a dismal air, but was much better in physical comfort than the day before, with its alternating rain and blistering heat. We found these fogs to be very common on this part of the river, being almost inseparable from the southern winds, the prevailing ones at this time of the year. I suppose the fog results from the moisture-laden air over the warm Pacific crossing the glacier-capped mountains of the Alaskan coast, and reaching this part of the Yukon valley with its aqueous vapor precipitated as rain or fog. About half-past one in the afternoon we floated past the mouth of the White River, coming in from the south, which has the local name of Yu-ko-kon Heen-a, or Yukokon River,

a much prettier name than the old one of the Hudson-Bay traders. The Chilcats call it the Sand River, from the innumerable bars and banks of sand along its course; and many years ago they ascended it by a trail, which, continued, leads to their country, but is now abandoned. Forty or fifty miles up its valley the trail leading from the head of the Tanana to old Selkirk crosses its course; and since Fort Selkirk was burned in 1851, the Tanana Indians, who then used it considerably to reach that point for trading, travel it but little. It seems to flow almost liquid mud (and no better example of its extreme muddiness can be given than to state that one person of the party mistook a mass of timber on the up-stream side of a low, flat mud-bar, for floating timber, and as evidence of a freshet, which seemed apparent from the muddy water, until its permanent character was established by closer observation). The mud-bar and adjacent waters were so exactly of the same color, that the line of demarcation was not readily apparent. The Indians say that it rises in glacier lands, and that it is very swift, and full of rapids, along its whole course. So swift is it at its mouth, that it pours its muddy waters into the rapid Yukon, and carries them nearly across that stream; the waters of the two streams mingling almost at once, and not running for miles distinct, as is stated in one book on Alaska. From its mouth to Bering Sea, the Yukon is so muddy that it is noticeable even when taken up in the palm of a hand; and all fishing with hook and line ceases.

About four in the afternoon the mouth of the Stewart River was passed, and, being covered with islands, would not have been noticed except by its valley, which is very conspicuous. A visit to the shore showed its mouth to be deltoid in character, three mouths being noticed, and probably more existing. Islands were very numerous in this vicinity, and covered with spruce and poplar. The swift current, cutting into their alluvial banks, kept their edges bristling with freshly fallen timber; and it was almost destruction to get under this *abatis* of trees with the raft, in the powerful current, and some of our hardest work was to avoid it,—a very hard thing to do, as, where they were the thickest, the current set in the strongest.

It may be necessary to explain how a greater amount of such fallen timber should exist on this river than on any other in the temperate zones equally wooded, and I think I can do so to the satisfaction of my readers. Fig. 10 represents a bank of any river, the stumps s s

¹ Concluded from No. 70.

representing trees, which, if undermined as far as *c*, will generally tumble in along *cd*, and carry away a couple of trees, the roots of

Yukon; the banks, as we saw them, being generally about eight feet above the level of the water. This is about the depth to which



not more than one being able to hold it so as to form an *abatis* along the bank. Fig. 11 represents a similar sketch on this part of the

the moist ground freezes solid; and the banks, therefore, have the tenacity of ice to support them; and it is not until the water has eroded

as far as *c* (five or six times as far as in fig. 10) that the superincumbent weight becomes great enough to break off the projecting bank along *c d*; and *c d S*, as a solid, frozen mass, tumbles in around the axis *c*, and, being too heavy for the water to sweep away, it remains until thawed out and washed away.

I have roughly attempted to show this in fig. 12. I think any one will acknowledge that the raft *R*, carried by a current sweeping towards *C*, is not in a very desirable position. It is generally bad enough on any river with a single line of trees along its scarp, but on the Yukon it is as much worse as I have shown. In fig. 12 the maximum is depicted just as the bank falls; and it requires but a few days for all the outer trees to be packed away by the swift current, and a less bristling aspect presented, the great mass acting somewhat as a barrier to again erode the bank for a long while. In many places along the river, this undermining had gone so far that the bank seemed full of caves; and, drifting close by, one could see and hear the dripping from the thawing surface, *c S* (fig. 11). In other places the half-polished surface of the ice could be seen in recent fractures as late as July, and even August.

On the 18th, shortly after noon, we passed a number of Indians on the right bank with sixteen canoes. It was probably a trading or hunting party, there being one for each canoe, and no women with them. About 8.30 p.m. we passed an Indian camp on the left bank, which, from the apparent good-looking quality of their tents as viewed from the river, we thought might be a mining-party. From them we learned that a deserted white man's store was but a few miles farther on, but that the man had left a number of months before, going down to salt water, as they expressed it. We camped that night at the mouth of a conspicuous but small stream coming in from the east, that we afterwards learned was called Deer Creek by the traders, from the large number of caribou seen in its valley at certain times of their migrations. At this point the

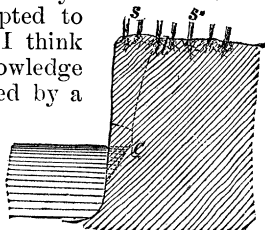


FIG. 10.

Yukon River is extremely narrow for such a distance from its head, and considering its previous mean width, being between two hundred and two hundred and fifty yards. It must have great depth, for its increase in current does not seem adequate to carry its previous volume.

Believing I was now near the British boundary, I reluctantly determined on giving a day (the 19th of July) to astronomical observations,—reluctantly, because every day was of vital importance in reaching St. Michael's, near the mouth of the river, in time to reach any outgoing vessels for the United States. That day, however, proved so tempestuous, and the prospects so uninviting, that, after getting a couple of poor 'sights' for longitude, I ordered camp broken, and we got off at 11.10 A.M. A few minutes before one o'clock we passed the abandoned trading-station on the right bank of the river, which, we surmised from certain maps, and information received afterwards, was named Fort Reliance. It was a most dilapidated-looking frontier pile of

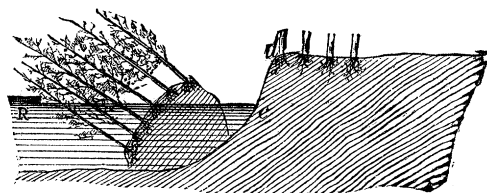


FIG. 12.

shanties, consisting of one main house, the store above ground, and three or four cellar-like houses, the roofs of which were the only parts above the level of the ground. We afterwards learned that the trader, Mr. McQuestion, had left, fearing some harm from the Indians.

Nearly opposite Reliance was the Indian village of Noo-klak-o, numbering about a hundred and fifty souls. Our approach was announced by the firing of from fifty to seventy-five discharges of guns, to which we replied with a much less number. This method of saluting is very common along the river, from here down, and is an old Russian custom that has found its way this far up the stream, much beyond where they ever traded. It is a custom often mentioned in descriptions of travels farther down the river. The permanent number of inhabitants, according to Mr. McQuestion, was about seventy-five to eighty; and therefore there must have been a great number of visitors among them at the time of our passing. They seemed very much disappointed that we did not visit them, and the

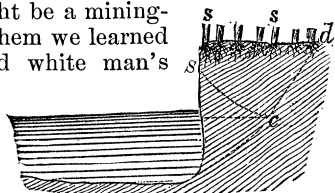


FIG. 11.

many that crowded around the raft spoke only of tea and tobacco. Their principal diet, I understand, is moose, caribou, and salmon. Their village is a semi-permanent but squalid-looking affair,—somewhat like those of the Ayans, but with a greater predominance of canvas.

Starting at 8.10 A.M., next morning, from camp 33, at 11.30 we passed a good-sized river coming in from the west, which I named the Cone-Hill River, from the fact that there is a conspicuous conical hill in its valley, near the mouth. Just beyond the mouth of the Cone-Hill River we saw three or four bears, both black and brown, in an open or untimbered space on the steep hillsides of the western bank. We gave them a volley, with no effect except to send them scampering up the hill into the

identify any of the smaller streams clearly from the descriptions and maps now in existence, and aided by the imperfect information gained from the local native tribes. Between 2.30 P.M. and 3 P.M. we floated past a remarkable-looking rock, standing conspicuously in a flat, level bottom of the river, and very prominent in its isolation.¹ It very much resembled Castle Rock on the Columbia, but is only about half its size. Dark, lowering clouds still obscured the tops of the river-hills. At half-past twelve we came upon an Indian village of a permanent character, of some six houses, on the western bank of the river, which is generally called Johnny's village, the Indian name being Klat-ol-klin. It numbered from seventy-five

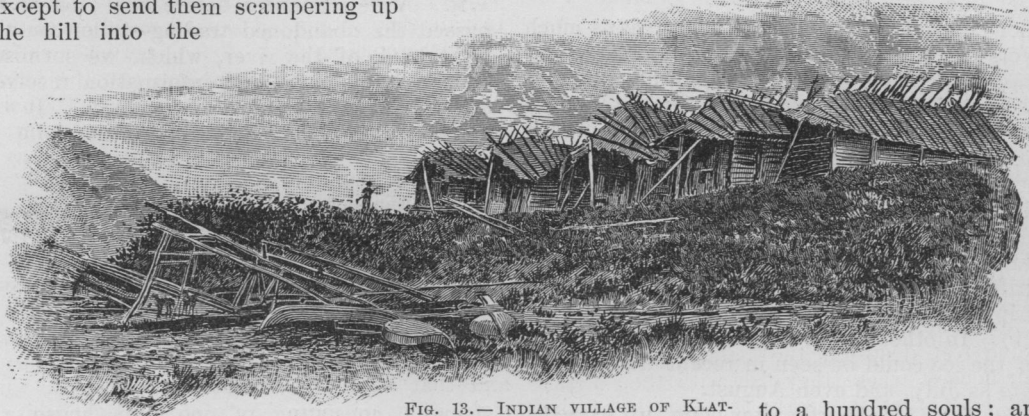


FIG. 13.—INDIAN VILLAGE OF KLAT-OL-KLIN, OR JOHNNY'S VILLAGE.

brush. I was told by a person in southern Alaska, undoubtedly conscientious in his statement, and having considerable experience, that the brown and black bear of his district never occupied the same localities, and although these localities might be promiscuously mixed, like the spots on a checker-board, yet each species of them remained rigidly on his own color, so to speak; and this led him to believe that the weaker of the two, the black bear, had good reasons to be afraid of his more powerful kind. This day's experience of the two kinds together, in one very small area, shows either an error of judgment of the observer mentioned, or a peculiarity of temper in the animals we saw. My authority spoke also of the manner in which the Indians persistently avoided the haunts of the brown bear, and this terror of that animal I found to exist as far as my travels extended.

After leaving the Stewart River, which had been identified by a sort of *reductio ad absurdum* reasoning, I found it absolutely impossible to

to a hundred souls; and on the gravel-beach in front of the row of houses

were probably from one-fourth to one-third as many canoes of the birch-bark variety, but larger and clumsier in construction than those of the Ayans. A number of long leaning poles, braced on their down-hill ends by cross uprights, were also seen; and these serve as scaffoldings for drying salmon, and to keep them from the many dogs while going through this process. While taking a photograph, two or three salmon fell from the poles; and in a twinkling, I think fully sixty or seventy dogs were in a writhing mass over them, each one trying to get his share. These dogs were of a smaller breed, and noticeably of a darker color, than the Eskimo dogs of the lower river. They subserve these Indians the same purpose. The body of the houses is of a very inferior quality of log construction, in which ventilation seems to be the predominating idea (although even then not to a sufficient degree, as judged by one's nose upon

¹ Called the Roquette Rock, after M. Alex. de la Roquette of Paris, France.

entering), and the large door in front is roughly closed by a well-riddled moose or caribou skin, or occasionally a piece of canvas. The roof is of skins battened down by spruce poles. The row of houses is so close to the scarp of the bank, that the 'street' in front is a narrow path, where two persons can hardly pass without stepping indoors or down the hill, and, when I visited the village, was so monopolized by scratching dogs that I could hardly force my way through. A fire is built on the dirt-floor in the centre of the habitation, and the smoke left to get out the best way it can. As the occupants are generally sitting flat on the floor, they are in a stratum of air comparatively clear; for the smoke can find air-holes through the cracks of the house-walls, while that which is retained under the skins of the roof is utilized to smoke the salmon which are hung up in this space.

It was at this village that to me the most wonderful and striking performance ever given by any natives we encountered on the whole trip was displayed, and in this I refer to their method of fishing for salmon. I have spoken of the extreme muddiness of the Yukon from the mouth of the White River; and this spot, of course, is no exception. I believe I do not exaggerate in the least when I say, that, if any ordinary pint tin cup was filled with it, nothing could be seen at the bottom until the sediment settled. The water is from eight to twelve feet deep on the banks in front of their houses, where they fish with their nets; or at least that is nearly the length of the poles to which the nets are attached. The salmon that I saw them secure were caught about two hundred and fifty or three hundred yards out from the bank, directly in front of the houses. Standing in front of this row of cabins, some person, generally an old squaw, possibly on duty for that purpose, would announce that a salmon was coming up the river, when some man, identifying its position, would run down to the beach, and pick up his canoe, paddle, and net, and start out into the river rapidly; the net lying on the canoe's deck in front of him, his movements being guided by his own sight and that of a half-dozen others on the beach and bank, all shouting to him at the same time. Evidently, in the canoe he could not judge well at a distance: for he seemed to rely on the advice from shore until the fish was near him, when, with one or two dexterous and powerful strokes with both hands, he shot the canoe to the position he wished; regulating its finer movements by the paddle in his left hand, while with his right he plunged the net the whole length of its pole

to the bottom of the river, from eight to twelve feet; often leaning well over, and thrusting his arm deeply into the water, so as to adjust the mouth of the net (covering about two square feet) directly over the course of the salmon. Of seven attempts, at intervals covering three hours, two were successful, salmon being caught weighing about fifteen pounds. How these Indians at this great distance can see isolated running salmon on the bottom of an eight or ten feet deep river, and determine their position near enough to catch them in the narrow mouth of a small net, when under the eye a vessel holding that many inches of water from the river completely obscures an object at its bottom, is a marvellous problem that I will not attempt to unravel; it of course depends in some way on the motion of the fish. In vain they attempted to show members of the party the coming fish. I feel perfectly satisfied that none of the white men saw the least traces that the natives tried to show. In their houses and on the scaffoldings were several hundred that had been caught in this way. The only respectable theory that I could evolve, was that the salmon came along near the top of the water, so as to show, or nearly show, the dorsal fin (for it borders on the marvellous that they could be seen at the bottom, or that any motion of theirs could be detected from the top when they were on the bottom, among the ripples of the swift muddy stream), and that when they neared the canoe, the sight of it, or more likely some slight noise, probably made on purpose, sent them to the bottom without any considerable lateral deviation, and that they were thus directed into the net; but my interpreter told me that this superficial swimming did not take place, but

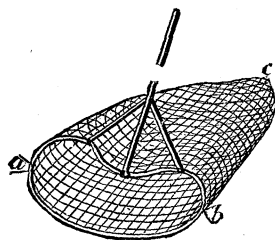


FIG. 14.

that the motion of the fish was communicated clear to the top from the bottom. The nets used I have partially described already. The mouth is held open by a light wooden frame of a reniform shape, as shown in fig. 14;

and, as one will readily see, this is of great advantage in securing the handle firmly to the rim of the net's mouth, and is undoubtedly the object aimed at. I might state here, that farther down the river (that is, in the 'lower ramparts') the reniform rim becomes circular, of course increasing the chances of catching the

fish; all the dimensions also become much larger. It may be interesting to state, that, when the fish is netted, a turn is given to the handle, thus effectually trapping it below the mouth; and, when brought up alongside, a fish-club (fig. 15) is used to kill it immediately, for the struggles of so large a fish might easily upset a fragile canoe. A number of Hudson-Bay taboggans were seen at the Indi-



FIG. 15.

an village, and near the trading-station, on scaffolds, and seem to be the principal sledges of the country. Their snow-shoes differed from those of the Chilcats only in immaterial designs.

The next day, the 22d, while under way, we saw a dead king-salmon floating belly upwards, and on the lower river saw a few, but never saw the numbers spoken of by previous travelers. I now noticed, in many places in the flat river-bottoms (with high banks, however), that the ground, especially in open places, was covered with a springy moss or peat; and if the bank was at all gravelly, so as to give good drainage, and allow the water to scour out underneath, as usual in temperate climes, and not in immense frozen masses, as previously described, this sphagnum was so tough that it would not go with the banks, but remained attached to that of the crest, forming great blankets a foot thick, that overhung the shores, as I have tried to show in fig. 16. Some of these banks were from fifteen to eighteen feet high, and this moss would reach to the water. I suppose the reason that it was more noticeable in open spaces was, that the trees and shrubs, and especially their roots, would, from undermining, carry the moss with their heavy weight into the water as they fell.

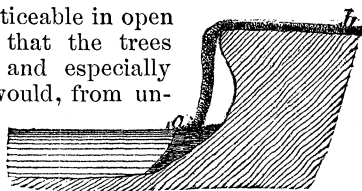


FIG. 16.

For the first time the soil seemed to be thick and black; and grass, always good, was now really luxuriant for any climate. At camp 36 we found rosebuds large and sweet enough to eat. They were much larger than those at home, somewhat pear-shaped; and the increase in size is entirely in the fleshy capsule, while even the seeds seem to be less 'downy' and dry than those of temperate climes. During the night of the 22d-23d the river rose ten inches, all of which, I think, can be accounted for by the recent continued summer rains.

At 3.30 of the 23d we sighted Charlie's village, as it is called; but the current was so swift that we could not get the raft in so as to camp alongside, but made a sand-bar half a mile below. Charlie's village was an exact counterpart of that of Johnny's, even as to number of houses; and considering this, and the trouble to reach it, I did not attempt to photograph it. Attempting to reach it with the raft, so anxious were the Indians that we should be successful, that as many as could do so, put the bows of their canoes on the outer log of the raft, and paddled with such vehemence that it seemed as if life depended upon success. We found a Canadian voyager by the name of Jo Sadue among them, who, as a partner of one of the traders on the lower river, had drifted here in prospecting the stream for precious mineral. Jo, as he is known, speaks of the natives of both of these villages as Tadoosh, and says that they are the best-natured Indians from here to the mouth of the river.

On the 24th the country seemed to flatten out, the hills having lower grades; but the mountains well to the westward still had patches of snow on their sides near the summits. About half-past ten we saw a large buck moose swim from an island to the mainland just back of us, having probably, as a hunter would say, 'gotten our scent.' About two in the afternoon the river widened out to a great extent, and was full of islands. Starting from camp 38, the river, as the map shows, becomes one vast network of islands, the whole country as level as the great plains; and, as we entered it, our Chilcats seemed seriously to think that we were going out to sea; indeed, a person having no knowledge of the country might well think so. Here the mosquitoes were a little worse than in the hilly country, and the gnats most decidedly so. As we started out into this flat country, the mountains to the left (or west) still continued in a range that was thrown back at an angle from the river's course, and that ran out in a spur that was still continued by a series of peaks rising out of the flat land, and diminishing in size until they disappeared towards the north-north-west. I called them the Ratzel range, or peaks, after Professor Ratzel of Munich.

The 27th of July we made old Fort Yukon (now abandoned as a trading-station), and connected our surveys with those of Capt. Raymond's party in 1869, thus giving a survey the whole length of the river.

FRED'K SCHWATKA,
Lieut. U. S. army.

PROTECTION OF ALPINE PLANTS.

EVERY one interested in alpine plants will be glad to hear that a society for their protection has been formed at Geneva. Before this time, attempts have been made by the governments of several Swiss cantons to protect plants, especially the edelweiss; which, however, is not a rare plant, and needs protection less than a host of its scarcer neighbors. Spain and Italy have already taken steps toward protecting their alpine floras; and the latter country hopes to obtain an edict from the government, which shall authorize the collection of rare plants, only by persons supplied with cards of permission.

The new society was founded in January, 1883, under the title 'L'association pour la protection des plantes.' Its formation at Geneva is particularly fitting; for, besides possessing the typical alpine flora, this place is the northern, and also the southern, limit of many plants. Being the great business and social centre, it is frequented by venders of the plants; so that any action there would strike at the principal source of drain: and, from its associations as the home of past and present eminent botanists, it is very suitable.

The aim of the society will be to check the wholesale collection of plants (and it is thought that the best means to accomplish this is to call the attention of the public to the injury done by the collection of plants with roots); to develop a taste for the cultivation of alpinists; and to induce gardeners to raise them, and sell them at a moderate price. These plans, especially the propagation in sale-gardens, have been approved by the Swiss and various other alpine clubs. Among the advocates of the plan of propagation is Alphonse de Candolle, who thinks that the action of the police and legal interference would merely raise the price of plants, and thus increase the incentive for their collection.

The custom of selling plants in the markets has not long been in vogue, yet long enough to show, that, unless effectually checked, the most injurious results will follow. It causes righteous indignation to all lovers of alpine plants to see the wholesale way in which, twice a week, the peasants (mostly the women) bring into Geneva and other markets these beautiful gems of the mountains, each in its season, — the rare rather than the commoner ones, as they naturally command a higher price. In fact, as has been said, one can make a botanical excursion without going out of the city. The flowers not sold soon fade and droop in the hot

sun, and are thrown aside as worthless; rarely do purchasers keep them longer than while they are in bloom: and thus are thousands of plants, roots and all, destroyed.

In the second bulletin of the society, a botanist writes that the societies for exchange of botanical specimens also offer much danger to rare species. The members, he says, are mostly amateurs, and obtain for their herbariums foreign plants by giving specimens of the rare plants of their own country; and this, in time, absorbs an immense quantity of specimens. He himself once communicated with one of these societies in order to obtain some rare plants. In return, an exorbitant list of the scarcest kinds was demanded, the quantity being frequently expressed as '*un char plein*,' '*le plus possible*,' etc. Besides these sources of drain, collectors from horticultural houses in England and Germany carry away great numbers of plants; professors and their pupils freely help themselves to rare species; 'botanical guides' aid in the devastation by directing collectors to rich localities; and vast quantities are collected for pharmaceutical purposes, or are sold as botanical albums or as herbariums.

Many localities, formerly rich in specimens, are now nearly or quite stripped of them; and it is time that these plants, perhaps the most universally attractive and admired in the world, should be protected from the disastrous war annually made upon them.

The society has attempted to check this abuse by spreading a knowledge of the danger by means of correspondence and publications. It has been suggested to post placards in Swiss hotels, requesting visitors not to collect roots, and informing them where they can purchase the same plants cultivated, in much better condition for transportation and future cultivation.

A most important result of the work of the society is, that a horticultural company has been formed for the cultivation and sale of such alpine plants as may be induced to grow in the valleys. Mr. Correvin, formerly director of the botanic garden of Geneva, and at present secretary of the Society for protection of plants, has been made superintendent of the establishment. It will raise plants from seed principally; and they can be purchased in pots, ready for transportation. There is no cause to fear for the success of the enterprise if the financial part proves prosperous, as the most attractive species of alpine Primulas, Campanulas, Dianthus, gentians, edelweiss, orchids, etc., have been successfully grown in Switzerland, in England, and some of them even in this country.

The new society now numbers some two hundred members, each of whom pays the small annual assessment of two francs. All persons are invited to join, and thus to assist this most worthy object, the expenses of which, especially in the way of publication, must be very considerable.

*THE DEEP-SEA CRUSTACEA DREDGED
BY THE TALISMAN.¹*

CRUSTACEA are distributed from the surface of the water to very great depths; and, at the exhibition of the Talisman collection, one may see

Islands, and which much resemble the *Portunus* of our coasts. On the other hand, they are very like species of the same genus, obtained at the Antilles, in the German ocean, and in the Mediterranean. The *Oxyrhynchi*, other triangular crustaceans of the group of *Brachyura*, are found lower than the last. *Lispognatus Thompsoni* was found between six hundred and fifteen hundred metres, on the Morocco coasts; and *Scyramathia Carpenteri*, in the same region, at twelve hundred metres. The former species had before been observed only in the German ocean; and the latter, north of Scotland and in the Mediterranean.

Crustaceans, intermediate in form between the brachyurans and macrurans, are found in abun-

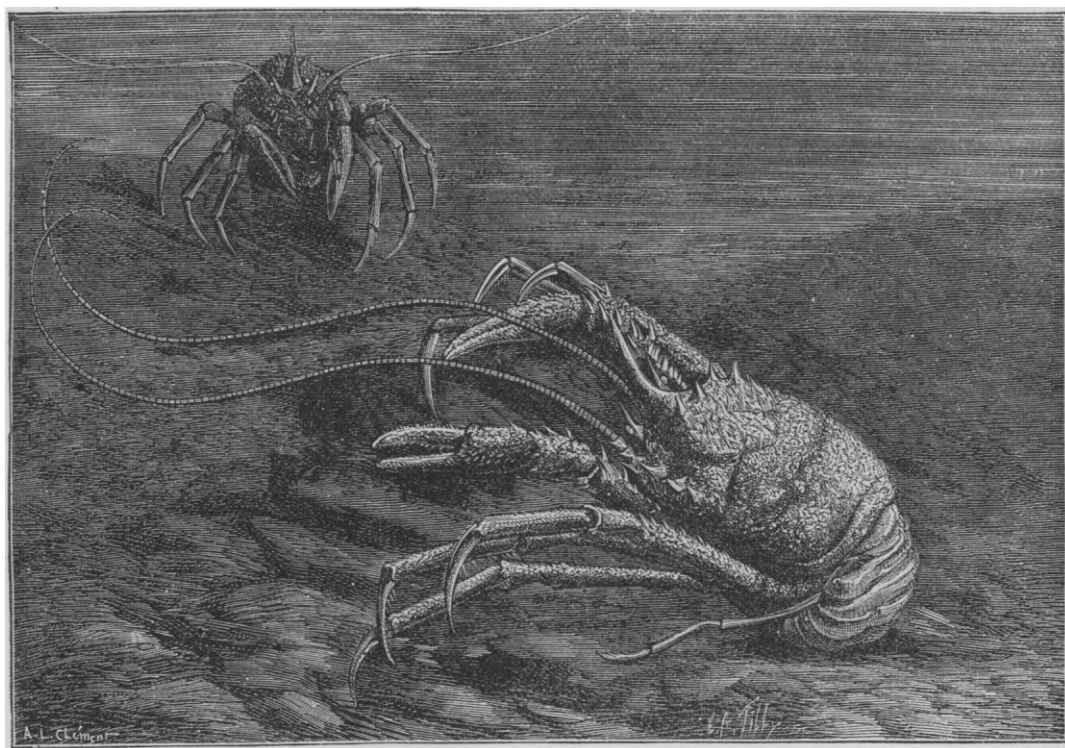


FIG. 1.—*GALATHODES ANTONII*, A BLIND CRUSTACEAN FROM A DEPTH OF 4,100 METRES. (NATURAL SIZE.)

Neptunus Sayi and *Nautilograpsus minutus* of the Sargasso, whose color they have assumed, side by side with other forms, as *Ethusa alba*, which is only found between four and five thousand metres below the surface. The swimming crustaceans, forming the group of *Brachyura*, are extremely rare at great depths. Certain forms of these crabs, taken on the Talisman, are remarkable for their geographical distribution, such as *Bathynectes*, found at four hundred and fifty and nine hundred and fifty metres, on the coasts of Morocco, and at the Cape Verde

dance in deep water. They seem to belong to genera between the two; and, in studying Crustacea, it is surprising to see types, which, taken separately, appear absolutely distinct, brought into contact by these intermediate forms. Thus the genera *Ethusa*, *Dorippe*, *Homola*, and *Dromia*, are linked together by many forms, with blended characteristics, rendering them difficult to classify. Several of the crustaceans are remarkable for their geographical distribution. Thus, on the coasts of Morocco, there was found a species of *Dicranomia*, noticed by Edwards in the Caribbean; and *Homola* of Cuvier, considered

¹ Translated from the French of H. FILHOL, in *La Nature*.

before as peculiar to the Mediterranean, was found extending from the coasts of Morocco to the Azores and the Canaries. But the most noticeable example of great geographical distribution is presented by *Lithodes*. These animals have hitherto been noticed only at the surface, in the waters of the poles. We found them at the tropics. But here, to meet the changed conditions of their surroundings, they have deserted their former depth for one of a thousand metres. This fact is important as bearing on the animal distribution of the oceans. It shows, first, that certain animal forms extend from northern seas

colony formed by beautiful Epizoanthi. These Zoanthi originally developed in a shell which has been gradually re-absorbed; and it is the cavity corresponding to this which this peculiar species of hermit-crab now occupies.

Galatheans have been found abundant at all zones; and the color of the body, generally reddish, becomes white with those living at great depths. Certain species establish themselves as lodgers in the interior of those beautiful sponges, the *Aphrocallistes*, whose tissue resembles lace. *Galathodes Antonii*, a new species, a specimen of which was taken below four

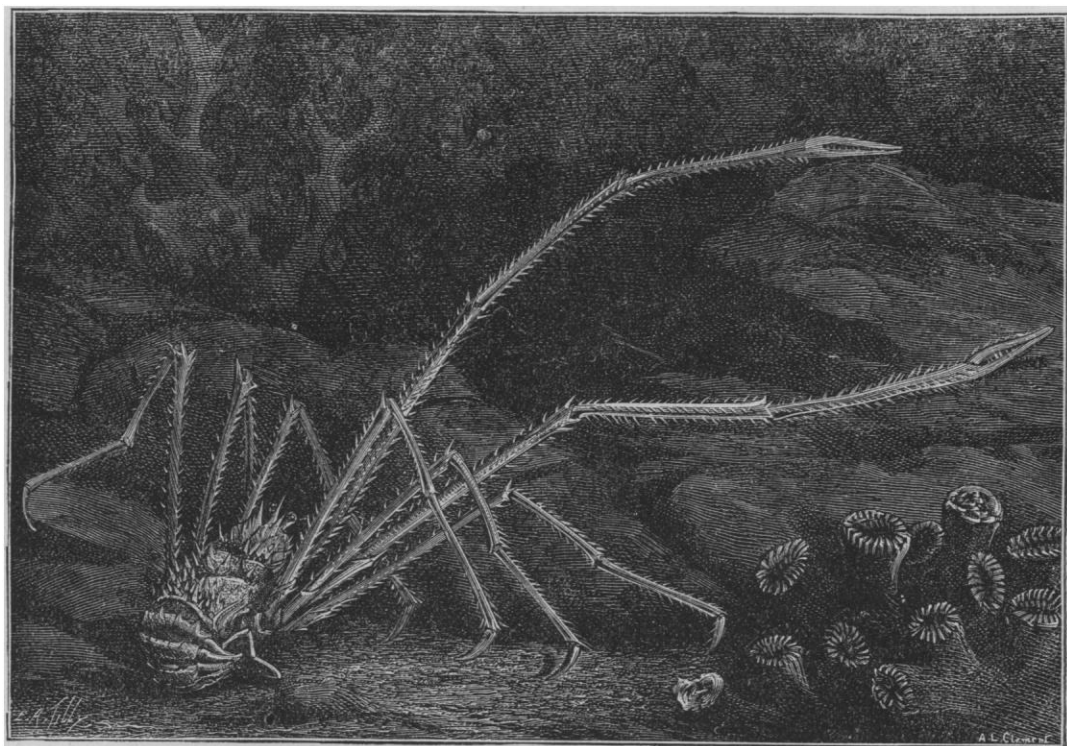


FIG. 2.—*PTYCHOGASTER FORMOSUS*, DREDGED FROM A DEPTH OF 950 METRES. (NATURAL SIZE.)

to the tropics; and, next, that animals from the poles have only to seek deeper water in proportion as they approach the warmer regions, to reach a zone suited to their organization.

The Paguri, commonly called hermit-crabs, have been found at five thousand metres. The bodies of these animals are protected only at the head and thorax; and, to shield their abdomens, they lodge in shells whose size corresponds to their own. But, as the shells of deep water are always very small, the abyssal Paguri obtain only very imperfect protection. One of these species, obtained on the Morocco coast and in the Sargasso, presents a very singular habitat. It lodges, not in a shell, but in a regular animal

thousand metres, is here figured (fig. 1). *Ptychogaster formosus* (fig. 2) is interesting on account of the position of its abdomen, folded twice upon itself.

The group of the Eryonides is represented by a number of species and genera. *Polycheles* and *Willemoesia*, whose tissues are so transparent that the stomach is visible through them, were taken at four and five thousand metres. The species of *Pentacheles*, common between one and two thousand metres, present forms very similar to those described in the fossil state, under the name of *Eryon*. At the exhibition of the Talisman collection, there is placed beside *Pentacheles crucifer* a calcareous plate coming from the Jurassic deposits of Solenhofen in

Bavaria, on which is the impression of an Eryon; and a comparison of these specimens impresses one with their great resemblance.

The macrurans, a group to which the crayfish

five or six times as long as the body; *Nematocarcinus* (fig. 3), whose claws are disproportionately long; *Oplophorus*; *Notostomus*, of a vivid red; *Acanthephyta*; *Pasiphae*, sometimes brown, sometimes

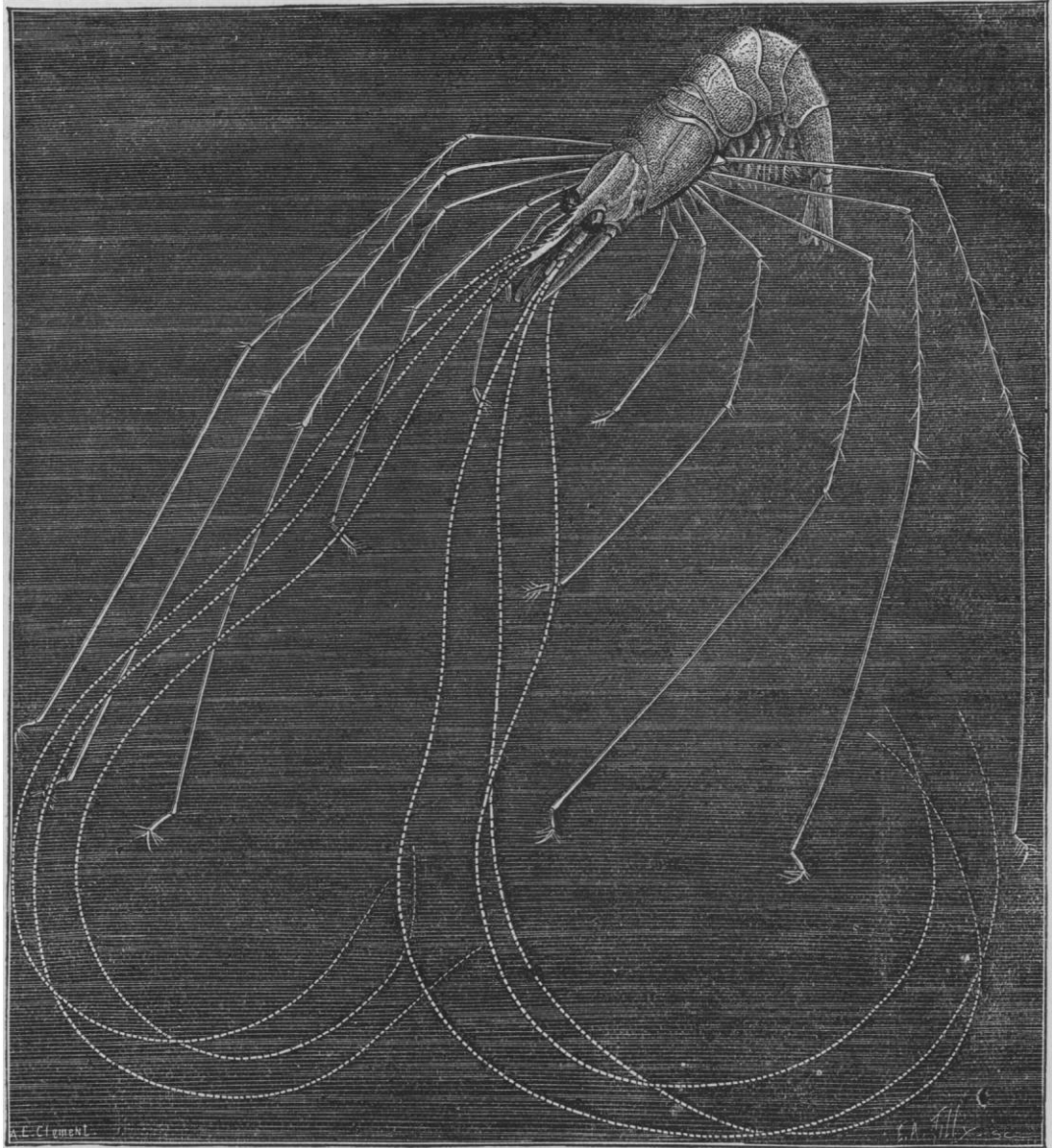


FIG. 3.—*NEMATOCARCINUS GRACILIPES*, TAKEN IN THE TRAWL AT A DEPTH OF 850 METRES. (NATURAL SIZE.)

belong, are abundant at all depths. At the Cape Verde Islands, at five hundred metres, a thousand individuals of a new species of *Pendale* were obtained. Among the most remarkable forms, I will mention a beautiful red *Aristes*, whose antennae are

rose-colored, often covered with red spots; and *Glyphus*, one species of which, *Glyphus marsupialis*, has a very strange arrangement, the lateral plates of the first abdominal segment being developed in the female to form a pouch for the eggs. I will call

attention, finally, among the schizopods, to Gnatauphausia, of large size, and of a scarlet color. The lower crustaceans, Amphipoda and Isopoda, were found in large numbers; but a study of them is much less interesting than that of the forms of which we have just spoken. The species of Nymphon is abundant at great depths; and a giant form, whose stomach extends to the end of its claws, Colossendeis titan, was taken at four thousand metres.

With crustaceans, as with fishes, it is very interesting to inquire whether the circumstances surrounding them cause modifications and adaptations in their organisms. The changes in the tissues are often noticeable in the structure of the carapace and muscles. I have already called attention to Pentacheles, Polycheles, and Willemoesia, whose tissues are so transparent as to allow the viscera to be seen; and the flesh is tender, and lacking flavor. The exterior colors are either a bright red, a rose-white, or a pure white. The macruran Crustacea are specially noticeable for their brilliant colors: and one cannot restrain a feeling of admiration for Aristes, of a carmine color; Notostomus, of a pure, deep red; and Pasiphae, spotted red and white. At very great depths, rose-white or pure white are the only tints observed.

With the fishes, as we have seen, the visual organs are always well developed, at whatever depth these animals are taken. It is not so with the Crustacea, several species of quite different groups having experienced atrophy, and sometimes a complete disappearance of the eyes. It is, however, a very singular fact, that some species in the same genus are blind, and others are not. Thus *Ethusa granulata*, living in the German ocean, between two hundred and thirteen hundred metres, is blind; while *Ethusa alba*, taken in the Atlantic, at five thousand metres, is not blind. The disappearance of the eyes seems to be gradual, and to be related to the depth at which the animal lives. The cornea first disappears, the ocular stalk remaining, and being movable. Then these parts become fixed, and, losing their characters, are changed into spines. Thus, says Norman, "*Ethusa granulata*, dredged between one hundred and ten and three hundred and seventy fathoms, has two remarkable ocular stalks, smooth and rounded at the extremity, where ordinarily the eyes are placed. With the specimens from the north, living at a depth of from five hundred and forty-two to seven hundred and five fathoms, the ocular stalks are no longer movable: they become fixed in the sockets, and their function is changed. Their dimensions are much enlarged; they approach their foundation; and, instead of being rounded, they end in a very firm rostrum. No longer serving as eyes, they serve as rostra." We have on exhibition one blind species, *Galathodes Antonii* (fig. 1), taken on the Talisman; and near this strange form, whose eyes are replaced by sharp spines, may be seen *Pentacheles*, *Polycheles*, *Willemoesia*, and *Cymonomus*, whose eyes are more or less changed.

Crustaceans of great depths emit phosphorescence. The light is shed, sometimes by the whole surface

of the body, and sometimes, as with *Aristes*, in a special manner, by the eyes themselves. With some of them it seems as if there were, in certain parts of the body, organs arranged for the production of this light,—a fact which recalls what was said about fishes. Thus in *Acanthephyra pellucida*, a new species, the claws are furnished with phosphorescent bands. The organs of touch are considerably developed, the most remarkable example of which is found in the long antennae of *Aristes*. With certain crustaceans, as in *Benthesismynus*, the last pair of claws assume the character of antennae, and have the same function, probably, as these organs.

THE WOBURN ROTATION EXPERIMENTS.

FOR the past six years some very interesting field-experiments have been in progress at Woburn, Eng., under the conduct of Dr. Voelcker, chemist of the Royal agricultural society. A portion of these experiments are upon the continuous growth of wheat and barley on the same land, and closely resemble the celebrated Rothamsted experiments, differing from them in being made upon light land. Other of the experiments are rotation experiments, and are designed to test the comparative agricultural value of artificial fertilizers, and of barnyard-manure made from different feeding-stuffs. These experiments are to be continued for a series of years; but a brief description of their plan, and a statement of the results obtained up to the present time, may not be without interest.

The rotation is an ordinary four-course rotation; viz., roots, barley, grass, and wheat. Sixteen acres are under experiment; so that, in any given year, four acres are covered by each crop, while, in the course of four years, each plot of four acres bears successively the crops above enumerated. The following table shows at one view the crops thus far carried by each plot:—

Date.	Plot 1.	Plot 2.	Plot 3.	Plot 4.
1877	Grass	Roots	—	—
1878	Wheat	Barley	Grass	Roots
1879	Roots	Grass	Wheat	Barley
1880	Barley	Wheat	Roots	Grass
1881	Grass	Roots	Barley	Wheat
1882	Wheat	Barley	Grass	Roots
1883	Roots	Grass	Wheat	Barley

Each plot of four acres is subdivided into four one-acre sections, and these are fertilized in different ways. As each of the four plots is treated exactly alike in successive years, it will suffice to follow one plot through the four years, in order to understand how each section of it is fertilized. Plot No. 1 was in grass in 1877, the grass being a mixture of clover and rye-grass. Sheep were pastured on each of the four sections of this plot sufficient to consume the grass. To the sheep on the first section were given 728 pounds of decorticated cottonseed-meal, and to

those on the second section the same weight of corn-meal, while on the third and fourth sections the sheep had only the grass. The droppings of the animals were left on the land; and, as fattening animals retain practically none of the fertilizing ingredients of their food, these droppings were richer on the first and second sections by the amount of plant-food contained in the cottonseed-meal and corn-meal respectively. In the fall the land was sown to wheat; and in the spring, sections 3 and 4, on which no ground-feed was fed, were top-dressed with commercial fertilizers. Section 3 received fertilizers containing amounts of nitrogen and mineral ingredients equal to the nitrogen and ash of the 728 pounds of cottonseed-meal fed on section 1; and section 4, in the same way, received nitrogen and ash equal to the amounts contained in the 728 pounds of corn-meal fed on section 2.

Thus the four sections of this plot permitted a comparison of the relative value for the wheat-crop, first, of stable-manure made from corn-meal and cottonseed-meal respectively, and, second, between the value of stable-manure and a quantity of commercial fertilizers containing the same amounts of plant-food. Following the wheat, mangolds were grown in 1879, variously manured on the four sections. On section 1 they received stable-manure made from 1,728 pounds of straw as litter, 5,000 pounds of mangolds, 1,250 pounds of wheat-straw, and 1,000 pounds of cottonseed-meal; on section 2, stable-manure made from the same amounts of food and litter, except that 1,000 pounds of corn-meal were substituted for 1,000 pounds of cottonseed-meal. On plot 3 they received stable-manure made from the same quantities of roots and coarse feed as were mentioned above, but without either cottonseed- or maize-meal, and, in addition to this stable-manure, commercial fertilizers equivalent to all the ash, and two-thirds of the nitrogen, of 1,000 pounds of cottonseed-meal. On plot 4 they received the same stable-manure as on plot 3, and, in addition, chemicals equivalent to the ash and nitrogen of 1,000 pounds of corn-meal.

Here, again, we have a comparison of stable-manure from different fodders with equivalent amounts of concentrated fertilizers. The stable-manure, in this case, was made by steers which were fed in so-called feeding-boxes, in which all the excrements and litter were retained, and compacted by the movements of the animal.

The mangolds produced on each section were weighed, and then fed out to sheep on the land. Following the mangolds came, in 1880, barley. This received no manure but the droppings of the sheep to which the mangolds were fed, except that section 2 received the remaining third of the nitrogen of 1,000 pounds of cottonseed-meal in the form of a top-dressing of nitrate of soda.

In 1881 the barley was followed by grass, to be fed off by sheep as described, thus beginning the rotation anew.

It will be seen, that, in the course of the four years' rotation, each plot furnishes three tests, with as many crops, of the manurial value of cottonseed-meal as

compared with maize-meal, and of each as compared with an equivalent amount of concentrated fertilizers. Moreover, since each one of the four plots is treated alike, three such comparisons can be made each year in different plots. Thus, by continuing the experiments for a series of years, it will be possible to eliminate from the results, to a certain extent, the errors which may arise from unequal quality of the soil on the different sections, and also to judge how the character of the season affects the action of the manures.

The subject is a very interesting one, and one which has received comparatively little attention experimentally. We know, indeed, with sufficient accuracy, the relations between the composition of food and that of the manure made from it. We know that in the manure of working, and of mature fattening animals, is found practically all the plant-food which their fodder contained. We know, that, in the case of growing animals and of those giving milk, more or less of the elements of plant-food pass into the new growth, or into the milk, and are lost to the manure; and we know approximately what proportions of them are thus lost on the average. With the necessary data as to amount and kind of food consumed, it is a comparatively easy task to compute the amount of valuable matters contained in the manure produced; but as to what modification the agricultural value of these matters may have undergone, and how it compares with the various forms of artificial fertilizers, we are comparatively ignorant. For example: we know that practically all the phosphoric acid of the food of a fattening animal passes into the excreta; but how the manurial value of this phosphoric acid compares with that of the soluble, the reverted, or the insoluble phosphoric acid of a superphosphate, with that of raw bone, or of native phosphates, can be, at best, only conjectured.

The Woburn rotation experiments promise to contribute to the solution of some of these questions. It would be premature to seek to draw definite conclusions from the results thus far obtained; for only a considerable length of time can enable us to estimate the effect of *continuous* treatment, of the sort described, upon the yield of the several crops. At the same time, a brief statement of them may furnish some interesting suggestions.

The following table contains the results, up to 1882, in pounds per acre, of the experiments on mangolds, barley, and wheat. Under the head of manuring are included only the amounts of cottonseed- or corn-meal fed to the sheep, or their equivalents in commercial fertilizers. It should be understood that this was not all the manure used, as will be evident on comparing the detailed description of a rotation given above.

In interpreting these results, there are some things which should be borne in mind. In the first place, we find in the reports of the above experiments, in the *Journal of the Royal agricultural society*, very meagre details as to their conduct. It is to be supposed that all four of the sections in each plot were

Results of Woburn rotation experiments.

MANGOLDS.

Sect.	Manuring.	1877 — Plot No. 2.			1878 — Plot No. 4.			1879 — Plot No. 1.			1880 — Plot No. 3.			1881 — Plot No. 2.		
		Roots.	Tops.	Total.	Roots.	Tops.	Total.	Roots.	Tops.	Total.	Roots.	Tops.	Total.	Roots.	Tops.	Total.
1	1000 lbs. cottonseed-meal	6,920	4,650	11,510	29,475	6,025	35,500	10,033	4,739	14,772	42,820	8,345	52,165	50,023	8,024	58,047
2	1000 lbs. maize-meal . . .	4,625	3,925	8,550	26,350	6,021	32,371	9,993	4,617	14,610	34,231	7,416	41,647	48,667	7,965	56,632
3	Ash and $\frac{1}{2}$ of nitrogen of cottonseed-meal . . .	16,188	7,575	23,763	40,820	8,125	48,945	17,676	6,433	24,109	55,050	8,306	63,356	54,718	9,100	63,818
4	Ash and nitrogen of maize-meal	8,400	5,650	14,050	28,537	7,130	35,667	12,847	4,875	17,722	46,838	7,420	54,258	48,600	8,356	56,956

BARLEY, AFTER MANGOLDS FED ON THE LAND.

Sect.	Manuring.	1878 — Plot No. 2.			1879 — Plot No. 4.			1880 — Plot No. 1.			1881 — Plot No. 3.		
		Grain.	Straw.	Total.	Grain.	Straw.	Total.	Grain.	Straw.	Total.	Grain.	Straw.	Total.
1	No fertilizers	2,008	3,132	5,140	1,781	2,966	4,747	1,947	2,782	4,729	2,256	3,067	5,323
2	No fertilizers	1,880	3,165	5,045	1,912	3,180	5,092	1,717	2,698	4,415	2,136	2,952	5,088
3	Nitrate of soda, containing $\frac{1}{2}$ the nitrogen of 1000 lbs. cottonseed-meal	2,291	3,825	6,116	2,085	3,132	5,217	1,897	2,989	4,886	2,267	3,158	5,425
4	No fertilizers	1,750	3,195	4,945	1,543	2,624	4,167	1,575	2,480	4,055	2,316	2,827	5,143

WHEAT, AFTER GRASS FED ON THE LAND.

Sect.	Manuring.	1878 — Plot No. 1.		
		Grain.	Straw.	Total.
1	728 lbs. cottonseed-meal	2,177	4,874	7,051
2	728 lbs. maize-meal	2,304	4,623	6,927
3	Fertilizers containing ash and nitrogen of 728 lbs. cottonseed-meal	2,686	6,376	9,052
4	Fertilizers containing ash and nitrogen of 728 lbs. maize-meal	2,118	5,479	7,597

Sect.	Manuring.	1879 — Plot No. 3.			1880 — Plot No. 2.			1881 — Plot No. 4.		
		Grain.	Straw.	Total.	Grain.	Straw.	Total.	Grain.	Straw.	Total.
1	672 lbs. cottonseed-meal	1,884	5,793	7,677	1,033	3,676	4,709	2,997	4,700	7,697
2	728 lbs. maize-meal	1,931	5,991	7,922	1,201	4,100	5,301	3,077	4,717	7,794
3	Fertilizers equivalent to 672 lbs. cottonseed-meal	2,034	7,168	9,202	999	4,218	5,217	3,114	5,369	8,483
4	Fertilizers equivalent to 728 lbs. maize-meal	2,022	6,377	8,399	1,116	3,976	5,092	2,943	5,149	8,092

cultivated, seeded, and otherwise treated, exactly alike; but no mention is made of the means adopted to secure accuracy in these respects. We are not told whether the composition of the fodders and fertilizers used was actually determined by analysis, or whether average composition was assumed for them. We have no comparison of the crops on the several sections as to the proportion of water they contained when weighed. Above all, we have no proof of the uniform quality of the land, and no knowledge of its natural capacity, as neither unmanured plots nor duplicate manurings were employed.

Under these circumstances, it is evident that no great weight can be given to small differences of yield, or to single results. On the other hand, a result which is repeated year after year, or which is very striking in amount, may serve as the basis of at least tentative conclusions.

Taking first the results on mangolds, we find, that, in every case, the manuring with cottonseed-meal was followed by a larger crop than was that with corn-meal; further, that in every case the fertilizers equivalent to the cottonseed-meal were followed by a larger crop than were those equivalent to the corn-meal; finally, that in every case but one (1881 — Plots 2 and 4) the commercial fertilizers were followed by a heavier crop than was the corresponding stable-manure.

Taking next the barley, and taking the figures as they stand, in three cases out of four the manuring with cottonseed-meal was followed by a larger yield, both of grain and of total crop, than was that with corn-meal.

In three cases out of four the grain, and in every case the total crop, were greater after the fertilizers equivalent to the cottonseed-meal than after those

equivalent to the corn-meal. In four cases out of eight the fertilizers were followed by a heavier crop than was the stable-manure. Many of the differences, however, are comparatively small.

In the wheat experiments the corn-meal manure proved superior to the cottonseed manure in every case as regards grain, and in three out of four cases as regards total yield. The fertilizers equivalent to the cottonseed-meal proved superior to those equivalent to the corn-meal in three cases out of four as regards grain, and in every case as regards total yield. The fertilizers surpassed the corresponding stable-manure in seven cases out of eight as regards total yield, while as regards grain the proportion is four to four.

Some of these results are quite different from those which we should have expected. Cottonseed-meal of good quality contains more than two and a quarter times as much nitrogen, four and a half times as much phosphoric acid, and four times as much potash, as corn-meal, and consequently the manure made from the former in these experiments must have been much the richer. The greater growth of the mangolds on the cottonseed sections accords with this fact, while the still greater effect of the commercial fertilizers corresponds with their greater solubility and consequent prompter action. With the barley and wheat, these results are far less marked. With the barley, they are mostly the same in kind. With the wheat, cottonseed-meal was excelled by corn-meal as a manure-producer, while otherwise the results were in the main the same as with the other crops.

A more careful examination, however, shows that the differences, both as to barley and wheat, are too small to be of very much significance. The greatest difference of yield of grain between the corn-meal and cottonseed sections was, in the case of barley, two hundred and thirty pounds per acre, equal to about five bushels, and, in the case of wheat, a hundred and sixty-eight pounds per acre, equal to less than three bushels. The differences in the total yield (grain and straw) are correspondingly small. It is certainly questionable, whether these differences are not less than the errors of experiment; and the only safe conclusion which we can draw is, that the yield was not greatly different in the two cases.

The commercial fertilizers showed greater differences; the richer manuring, containing the equivalent of the cottonseed-meal, generally proving decidedly superior, particularly as regards the total yield, the grain being not so much affected.

As compared with the stable-manures, the fertilizers show but a slightly larger yield of wheat. The barley, it must be remembered, received no manure or fertilizers directly, except a light top-dressing of nitrate of soda on section 3, but only the droppings of the sheep fed on the mangolds of the preceding year.

It is not the purpose of this article to theorize as to the reasons of the results obtained in these experiments, and such theorizing would be premature at present. One thing is shown very plainly by them, however; and that is, that, in all discussion of methods

and systems of fertilizing the soil, two aspects of the question must be clearly distinguished. We may regard manures either as direct sources of food to the plant, or as means of enriching the soil, and accordingly distinguish between the immediate returns which they yield, and their value as an investment. In these experiments there can be no doubt that the cottonseed sections received more plant-food than the corn-meal sections in every case, and we have no reason to suppose that this plant-food would not all become available at some time; but the immediate returns were not always greater. In the comparatively short time during which the experiments have been in progress, it has been the immediate value of the manures and fertilizers used which has manifested itself.

Whether, after a number of years, the richer manuring will not show better results on the grain-plots, is a question which, *a priori*, would receive an affirmative answer; and the testimony of experiment on this point will be awaited with interest.

H. P. ARMSBY.

THE AMERICAN FISH-CULTURAL ASSOCIATION.

THE annual meeting of this association was held in the lecture-room of the National museum at Washington, on May 13, 14, and 15. President Benckard made an address of welcome, and briefly reviewed the work of the association for the past year.

Many papers were read, and the attendance was good throughout. Mr. F. Mather gave an account of the hatching-work at Cold Spring Harbor, stating that the eggs of the tom-cod had been successfully hatched there this spring.

Prof. H. J. Rice related his experiments with various substances used to destroy the Saprolegnia, the fungus which attacks fishes in aquaria. The most successful results were obtained by the use of a bath of common salt. Fishes which were badly infested with the fungus, after immersion in a moderately diluted solution of salt and water for a minute or so, after a while had the adherent film of fungus loosened in large flakes. This method, if applied in time, would prove effectual, if one were afterwards careful not to introduce into the aquarium organic material which would decompose, and afford a nidus for the nourishment and multiplication of this pest from its spores.

Mr. L. Stone read a paper on the artificial propagation of salmon in the Columbia-River basin, taking the ground that it was probably now too late to begin propagating these fishes in some of the most depleted branches of the Columbia.

Mr. C. G. Atkins gave some important data respecting the rate of growth, and facts regarding the habits of land-locked salmon. In reply to questions by Mr. G. B. Goode, the speaker thought that the land-locked salmon did not hybridize with the common salmon under natural conditions; nor did he think that there was evidence at present to prove that the

land-locked salmon had descended from the sea-salmon, though the latter was probably the ancestor of the former.

Dr. W. M. Hudson, of the Connecticut shell-fisheries commission, gave an interesting account of the great work in progress in extending the area of the oyster-beds in the waters of Connecticut by sowing shells, together with a small proportion of live oysters, over the bottom, in waters not before productive. The statistics presented by the author showed that this industry had developed within a very short period to amazing proportions in his state, mainly through the enlightened administration of the commissioners, and the enactment of good protective laws by the state legislature. The speaker also gave a synopsis of the laws regulating the ownership of the beds, which he said were working admirably, and concluded by saying that the worst enemies of the oyster in his state were the star-fishes and human poachers, being undecided in his own mind which of the two was the worse. Steps were being taken to have all the star-fishes which are dredged destroyed.

Lieut. Francis Winslow, U.S.N., read a long paper on the present condition and future prospects of the oyster-industry, in which he showed that the beds of Virginia and Maryland were being depleted by excessive dredging, and commended reparative measures, such as were in successful operation in the waters of Connecticut. His paper was illustrated by a large and important series of charts, upon which were mapped almost all of the oyster-beds of the eastern coast of the United States, showing the depth of water in which the beds lie, and, as far as possible, their present condition.

Mr. G. Brown Goode presented a paper on the oyster-industry of the world, which is seated chiefly in the United States and France. Great Britain has still a few natural beds remaining, and a number of well-conducted establishments for oyster-culture. Canada, Holland, Italy, Germany, Belgium, Spain, Portugal, Denmark, Norway, and Russia have also oyster-industries, which are comparatively insignificant, and, in the case of the last two countries, hardly worthy of consideration in a statistical statement.

Recent and accurate statistics are lacking, except in two or three instances. A brief review by countries, in the order of their importance, was presented. The oyster-industry of the United States was shown to employ 52,805 persons, and to yield 22,195,370 bushels, worth \$30,438,852; and that of France, in 1881, employed 29,431 persons, producing oysters valued at \$3,464,565; the industry of Great Britain yielded a product valued at from two to four millions of pounds sterling; Holland was shown to have a considerable industry in the province of Zealand, and to have produced native and cultivated oysters to the value of \$200,000; Germany has an industry on the Schleswig coast valued at about \$40,000; while the products of other European countries mentioned was too insignificant to deserve a place in this brief abstract. An estimate of the total product of the world was presented as follows, the figures being given in the number of individual oysters produced:—

Countries.	No. of oysters.
United States ¹	5,550,000,000
Canada	22,000,000
Total for North America	5,572,000,000 *
France	680,400,000
Great Britain	1,600,000,000
Holland	21,800,000
Italy	20,000,000
Germany	4,000,000
Belgium	2,500,000
Spain	1,000,000
Portugal	800,000
Denmark	200,000
Russia	250,000
Norway	250,000
Total for Europe	2,331,200,000

The oyster-industry is rapidly passing from the hands of the fishermen into those of oyster-culturists. The oyster, being sedentary except for a few days in the earliest stages of its existence, is easily exterminated in any given locality; since, although it may not be possible for the fishermen to rake up from the bottom every individual, wholesale methods of capture soon result in covering up, or otherwise destroying, the oyster banks or reefs, as the communities of oysters are technically termed. The main difference between the oyster-industry of America and that of Europe lies in the fact, that in Europe the native beds have long since been practically destroyed, perhaps not more than six or seven per cent of the oysters of Europe passing from the native beds directly into the hands of the consumer. It is probable that sixty to seventy-five per cent are reared from the seed in artificial parks, the remainder having been laid down for a time to increase in size and flavor in shoal waters along the coasts. In the United States, on the other hand, from thirty to forty per cent are carried from the native beds directly to market. The oyster-fishery is everywhere carried on in the most reckless manner; and in all directions oyster-grounds are becoming deteriorated, and in some cases have been entirely destroyed. It remains to be seen whether the governments of the states will regulate the oyster-fishery before it is too late, or will permit the destruction of these vast reservoirs of food. At present the oyster is one of the cheapest articles of diet in the United States; while in England, as has been well said, an oyster is usually worth as much as, or more than, a new-laid egg. It can hardly be expected that the price of American oysters will always remain so low; but, taking into consideration the great wealth of the natural beds along the entire Atlantic coast, it seems certain that a moderate amount of protection will keep the price of seed-oysters far below European rates, and that the immense stretches of submerged land especially suited for oyster-planting may be utilized, and made to produce an abundant harvest at much less cost than that which accompanies the complicated system of culture in France and Holland.

Mr. J. A. Ryder thought that purely artificial

¹ On the basis of 250 oysters to the bushel.

methods, applied to the propagation of the oyster, were not as unpromising as some seemed to suppose. This much, at least, was certain, — that a simple method of confining the fry so as to prevent its escape from partially land-locked waters was practicable, and would doubtless be found to be a valuable aid in oyster-culture in the future.

Mr. George S. Page read a paper on the success with which certain lakes in Maine had been stocked with black bass from fish taken from New York.

A paper was then read by Col. M. McDonald on the natural causes influencing the movements of fishes; the author remarking, that in aquaculture, as in agriculture, a number of conditions necessarily concur in determining production. Many of the conditions are capable of being modified by man's agency. His influence in determining increased production, either on the land or in the water, is measured by the increase in average production, which he may effect by modifying favorably the natural conditions which are under his control.

The most important condition determining the fluctuations in the aggregate number of fish taken year by year is the temperature of the medium in which they live. In the case of the shad (*Alosa sapidissima*), the study of records of water-temperature would seem to indicate that it is ever moving, in its ordinary migrations, towards a temperature of 60°. Assuming this to be true, we should expect in an area like the Chesapeake, limited and bounded seaward by a wall of low temperature, always to find the shad in that portion of this area which approximated more nearly to 60°. To trace the shad in their migrations, it is only necessary to determine the shifting of this area of congenial temperature under the influence of the seasons. Our temperature records for 1881, 1882, and 1883, indicate, that, for the winter months, the area of maximum temperature is not in the rivers, nor in the bay, but on the ocean plateau outside, extending from the capes of the Chesapeake to the Delaware Breakwater. The presumption, therefore, is, that the schools of shad belonging both to the Chesapeake and the Delaware have their common winter quarters on this plateau. When, under the influence of the advancing seasons, the waters of the Chesapeake and the Delaware bays become warmer than those of this plateau, the migration into continental waters begins. The proportion of the run that will be directed to the Delaware or to the Chesapeake will be determined at this early period. If the water at the northern end of this area warms up more rapidly than at the southern, then an undue proportion of the shad will be thrown into the Delaware. On the other hand, cold waters coming down the Delaware may effect the contrary movement, and throw the schools almost entirely into the Chesapeake; thus leading to a partial or total failure of the shad-fisheries of the Delaware for the season.

When the schools of shad have entered the Chesapeake, their distribution to the rivers will be determined in the same way by temperature influences. If the season is backward, so as to keep down the

temperature of the larger rivers which rise in the mountains, then the run of shad will be mainly into the shorter tributaries of the bay, which have their rise in the tide-water belt, and, of course, are warmer at this season than the main rivers. Again: warm rains at the beginning of the fishing-season, and the absence of snow in the mountains, will determine the main movement of the shad into the larger rivers of the basin; and if, when the schools enter the estuaries of these rivers, they encounter a temperature considerably higher than that in the bay itself, the movement up the river will be tumultuous, the schools of shad and herring all entering and ascending at once, producing a glut in the fisheries, such as we sometimes have recorded.

We see, therefore, in the light of these facts, that we may have a successful fishing-season on the Delaware, accompanied by a total or partial failure in the Chesapeake area, and *vice versa*; and, considering the Chesapeake area alone, we may have a very successful fishery in the aggregate, yet accompanied by partial or total failures in particular streams, under the influence of temperature conditions. If statistics of the shad-fisheries are to furnish a measure of increase or decrease, they must include the aggregate catch of the Chesapeake and Delaware River, and, indeed, of rivers much farther to the north. Statistics based upon a comparison of the catch in the same river, in different seasons, are of no value as serving to give a measure of the results of artificial propagation.

That the aggregate production of the shad-fisheries of the Atlantic coast is on the increase, is shown by the fact, that, in the face of an ever-increasing demand, prices have not only been held at what they were in 1879, but have been sensibly reduced.

Mr. J. A. Ryder made a communication upon some of the forces which limit or determine the survival of fish embryos, remarking that different species of fishes differed very widely in respect to the number of ova produced by a single female during one season. After a comparison of the habits of the different forms, and after some attention had been bestowed upon the contrivances intended for the protection of the eggs and young which are developed by the parent fishes of certain species, as well as the protective adaptations developed by different ova, the speaker had concluded that the number of survivals out of any given brood of eggs was dependent upon the amount of such natural protection afforded them; that such a protective influence likewise tended to diminish the number of ova produced by a species during a single season just in proportion as such natural protective agencies were most effectual. This view the speaker thought was strongly supported by what is known of such species as commit their eggs to the mercy of the environment, as in the case of cod, with its two to nine millions of eggs left to float and hatch on the surface of the ocean; in which case a very small percentage of germs ever reach adult age, whereas every one of the six to twenty-five eggs of a viviparous or nest-building species grows at least large enough to begin the struggle for existence with

the environment, under circumstances a hundred-fold more favorable to their survival than the young of a totally unprotected form, or one only partially protected from immediate destruction by the buoyancy of its germs or ova.

The natural limitations of the supply and proper kinds of food were also alluded to, and some of the early imperfections of fish embryos pointed out, some having an imperforate oesophagus at the time of hatching, so that at this time they cannot take food. The relative strength of the embryos of different species at the time of leaving the egg was also shown to be dissimilar in the cases of those species which do not protect their broods; and it was suggested that such absence or presence of embryonic vigor might have an influence in diminishing or increasing the chances of survival.

The point, however, which the speaker wished especially to insist upon, was, that, other things being equal, it was probably true that the number of survivals out of a brood of eggs stood in nearly an inverse proportion to the number of germs actually produced, and that natural or adaptive protective agencies tended to diminish the fecundity of a species, just as a want of such protective endowments tended to increase fertility in order, apparently, to compensate for the wholesale destruction of such germs during their early and critical stages of development.

Dr. Theodore Gill, commenting upon Mr. Ryder's remarks, said that the facts just reported afforded a broad inductive basis for the doctrine, that, in proportion as the eggs of a species of fish were protected by the parents, just in that proportion were the chances of survival of the individual young increased, and the number of eggs correspondingly diminished. The speaker thought that it was not generally understood that many fishes were in the habit of caring more or less for their young, and that this ignorance was due to the fact that very few of the well-known fishes of Europe had such habits; and our popular writers, who draw so largely from European literature upon such subjects, failed to appreciate how frequently such was the case with our native forms. Citing the case of certain marine cat-fishes which hatch their young in the mouth, besides others which carry their ova upon processes on the abdomen, the speaker desired especially to call attention to the fact that about two-thirds of the sharks and rays, or elasmobranchs, were viviparous; the young undergoing their embryonic development within the body of the parent.

Mr. E. G. Blackford of New York read a paper entitled 'Is legislation necessary for the protection of the ocean-fisheries?' Judging from his own experience and observation for many years past as a dealer, he would hesitate regarding the expediency of legislative interference with the ocean-fisheries; which opinion he illustrated by statistics, and concluded by saying that probably the only fishery-products of which the supply had been perceptibly diminished by over-fishing, during the last fifteen years, were the striped bass, or rock-fish, and the lobster.

Mr. Joseph Willcox gave an account of his obser-

vations upon the sponge fauna and fisheries of the shallow waters of the west coast of Florida, north of Tampa Bay. About thirty species of fibrous, calcareous, and siliceous sponges were collected by him in this region; and he suggested, that, in view of the fact that fishing for the valuable fibrous or ceratose sponges of commerce was becoming less remunerative, steps ought to be taken to artificially propagate such forms as were of economical value.

Prof. W. O. Atwater of Middletown, Conn., gave a very interesting *résumé* of his investigations upon the subject of the chemical composition and nutritive value of American food-fishes and invertebrates. These investigations were directed to the determination of the percentages of proteids, carbohydrates, water, and refuse, contained in flesh-foods of different kinds: the results were carefully tabulated, and afford important data for the determination of the relative values of different fishes and mollusks as compared with other meats. Some of the results arrived at are quite remarkable: for example, a hundred pounds of oysters were found to contain very little more proteine than the same weight of milk, when the waste (that is, the shells) of the oysters was considered in the analysis. When the edible portion alone was analyzed, the nutrient matters contained in the oyster were found nearly in the same quantity as in codfish from which the head and entrails had been removed. The actual cost of the proteine consumed as food, it was shown, varied between very wide limits: for example, if consumed in the form of salmon early in the season, at one dollar per pound, the cost of proteine to the consumer was at the rate of five dollars and seventy-two cents per pound. If consumed in the form of the alewife, at three cents per pound, the actual cost of the proteine per pound was only nineteen cents. The nutritive value of different fishes was also found to vary considerably; that is to say, the percentage of proteine and carbohydrates is variable in quantity in different species. Thus, the percentage of available food-materials in the whole flounder is only five and three-tenths per cent, while in fat mackerel it is twenty-four and two-tenths per cent.

The presence of only a small percentage of carbohydrates in fish-food was noted, in which respect it contrasts strongly with fat pork and beef, which are rich in proteine and carbohydrates, and with farinaceous foods, which are poor in proteine; indicating, that, as an adjunct to these, fish-foods have a high value in all dietaries.

Mr. Richard Rathbun presented a paper on the decrease in the abundance of lobsters, briefly stating his conclusions regarding the supposed decrease in their number, based upon materials gathered from many sources in the interest of the tenth census, and still unpublished.

The lobster-fishery, as a separate and distinct industry, was first started about the beginning of the present century, on the coasts of Massachusetts and Connecticut, and only as late as 1840 on the coast of Maine, where it has since attained its greatest development. The vicinity of Provincetown, Cape Cod,

was at one time, about twenty-five to fifty years ago, the principal source of supply for the larger markets of the country, and especially for New-York City; and the trade between these two places was of great importance. The Cape-Cod grounds are now, however, so nearly depleted that the annual catch is of very slight value. Other important areas have shown indications of a similar decrease; and the market supplies have been increased from year to year only through a great extension seaward of the fishing-grounds, and the much greater number of traps used. A suggestive indication of the decrease in abundance of lobsters is furnished by the marked decrease in the average size of those now taken to supply the trade.

The fact was noted that the lobster is not a truly migratory species, but simply moves into slightly deeper water on the approach of cold weather, to return again to the same shallow areas as the spring advances. Continued over-fishing in any one region will therefore tend to reduce the stock of lobsters in that region, without the probability of its being rapidly replenished by migrations from a neighboring region; and the greater or less depletion of many areas may be explained in that way.

The solution of the problem as to how the fishery may be protected in the interests of the fishermen and the trade must be reserved for future investigations; but existing laws do not appear to give the desired benefits.

On Tuesday evening the association met in the hall of the National museum, to listen to an address by Hon. Theodore Lyman of Massachusetts, who reviewed the work of the U. S. fish-commission and of the state commissions in an able manner.

Hon. Theodore Lyman was elected president of the society for the ensuing year; and during the return trip from the river-excursion on the steamer Fishhawk, the name of the association was, after considerable discussion by the members present, changed to the 'American fisheries society.' A conference of all of the state fish-commissioners present at the meeting, with the U. S. commissioner of fish and fisheries, Professor Baird, was held on the 15th.

MEETING OF MECHANICAL ENGINEERS AT PITTSBURGH.

THE meeting of the American society of mechanical engineers at Pittsburgh, May 20-24, was in many respects one of the most interesting that has been held. The attendance was as good as usual, say twenty-five per cent of the membership, and the quality of the papers above the average. The arrangements for the social comfort and enjoyment of the guests were not, however, so complete as at the last spring meeting. It was a mistake, that the announcement of a *conversazione* and social re-union was not carried out, and an opportunity given, early in the meeting, for the formation and renewal of acquaintances. The excursions so generously provided were of great interest; but we venture the assertion that the mass of the visitors gained but little accurate information. By providing

for such an occasion an appropriate manual or guide, or possibly a larger reception committee, the advantage to the guests can easily be quadrupled. It might even be better, as was done at the last meeting, to devote the whole day to a well-planned visit to a single establishment.

The society met in joint session with the Engineers' society of western Pennsylvania, whose president, Mr. Miller, welcomed the visitors, and invited their president, Prof. John E. Sweet (formerly of Cornell university), to the chair. The evening of May 20 was devoted to the report of Messrs. Roberts, Phillips, Hunt, McDowell, and Jarboe, — a committee appointed, at the January meeting of the local society, to investigate the whole subject of natural gas. There are also a city, and an underwriters' committee on the same subject.

Though Pittsburgh is within reach of three or four prolific localities, and gas has been used for many years, it is but recently that any organized effort has been made to use it on a large scale. Already there are a hundred and fifty companies chartered in the state, representing over two million dollars; and gas is brought from eight to twenty-five miles for use in the city. Five-inch mains are being followed by eight-inch, new wells are being bored, and the time when Pittsburgh shall become a smokeless city may not be far distant. Though the gas is used under a pressure of a few ounces, the pressures at the wells run from fifty to a hundred and twenty-five pounds: this is due to the friction in the mains, five pounds being allowed for each mile. If the flow be shut off the pressure runs up much higher, and great difficulty has been experienced in making tight joints; cast-iron is too porous, and ordinary pipe-threads do not fit well enough. A number of new coupling-devices were exhibited, in some of which a lead packing was used. No allowance for expansion need be made, as the gas maintains an even temperature of about 45° F. When gas is allowed to burn freely at the mouth of a well, the cold produced by the expansion is such that ice has been projected through the flames.

The gas is used in all kinds of furnaces for making steam, iron, glass, etc.; and electric-light carbons, and the finest lampblack for printing-inks, are made from it: but it is used with suicidal wastefulness, which causes anxiety, as many wells give out in less than five years. The report looks to its economic and safe control. For household use it might otherwise be dangerous; and such use has commenced, though no practicable method of deodorizing it has been found. Being composed largely (ninety-six per cent) of marsh-gas, its value as a heating-agent is high, and its density is about half that of air. One pound (23.5 cubic feet) of gas has a theoretical evaporating-power of twenty-four pounds of water, twenty pounds having been actually evaporated. The best method of burning it is not generally known: experiments with injector-burners show that they do not suck in sufficient air for complete combustion, and the best results have been from numerous jets in contact with the whole heating-surface of the boiler. The value of the gas, as compared by evaporation tests with coal at \$1.40

per ton, is only eight cents per thousand feet (which suggests that even our ordinary gas companies make profits), but its use is immensely more convenient; no stacks are needed, and the furnace reduces to a simple non-conducting chamber. The gas has just been turned on to the city water-works; and on the afternoon of May 22 a well was reported on the property of Mr. Westinghouse, near Pittsburgh. On the first day's excursion numerous furnaces were seen running with gas blown in through rough, one-eighth inch nozzles; and two or three lines of five-inch pipe lay on the surface of the railway embankment.

Mr. J. W. Cloud, engineer of tests for the Pennsylvania railroad, read a paper on helical springs. It was here claimed that round steel is better than square, flat, or other shaped; and an investigation, mathematical and experimental, was described, on the usual and mainly correct hypothesis that the strains are entirely torsional. Bars of oil-tempered and untempered steel, five feet long by three-fourths to one and five-sixteenths inches diameter, had been tested, and the constants of elasticity, etc., obtained; after which the springs had been coiled and again tested, and the results compared with theory. The proper arrangement of springs, when several are used together, was discussed, and certain proportions shown to be necessary for springs arranged concentrically. Detail drawings of springs for classes V and X were shown. Experiment has proved the principles to be correct on which these have been designed. Altogether, the paper is valuable as the commencement of an investigation, which, pushed to completion, will render the designing of all kinds of helical springs an exact science. In the discussion it appeared that springs of peculiar shape found their way into the scrap pile; that the introduction of peculiar designs under freight-cars often resulted in an enormous percentage of breakage; that orders to manufacturers are often arbitrary, and contrary to sound principles; that logs are loaded on cars by dropping them from a height of ten feet; and that springs are tested by pounding them together with a steam-hammer, after which they are expected to stand ordinary wear.

The greatest scientific interest, however, attached to the paper of Prof. W. A. Rogers of Cambridge, on a practical solution of the perfect-screw problem. Professor Rogers prefaced the reading by remarking that he considered the American society of mechanical engineers the most appropriate body to receive his first public announcement of success,—a courtesy appreciated by the society. Mechanism of precision was defined as perfect "when it meets all the requirements of the purpose for which it is constructed;" and the two screws, which raise the cross-head of an iron-planer, were discussed in this respect. Precision-screws are tested, not only by direct measurement of the pitch, but by examining optically a surface ruled with many thousand lines to the inch by means of the screw. The first catches all accumulated errors, while the 'diffraction grating' tests the regularity of the spacing for short distances. Scales graduated in Europe, and advertised as without sensible error, are shown, under the comparator,

to merit no such claim: indeed, if we except Professor Rowland's, no screw has hitherto been made, capable of producing graduations sufficiently exact. Three half-metre screws were exhibited which could be mounted for microscopical examination: on one of them, over twelve hundred hours had been spent to make it, by usual methods, as perfect as possible; another, made by the new process, had required but twenty-two hours, and yet, while the microscope showed great irregularities in the former, none could be detected in this; the third was a similar screw before its final grinding. Professor Rogers produces a perfect screw by the following process: an ordinary, well-constructed lathe is used; and cuts of various depths are taken on a preliminary screw, for the purpose of tabulating the errors of the leading screw of the lathe as compared with a standard measuring-bar. This being done, a micrometer-screw is used to vary the relation between the leading screw and the cutting-tool. This screw is kept moving automatically, or by hand, so as always to correspond with the tabulated values, which results in producing a screw nearly free from the errors of the leading screw. This screw is then ground with a nut cut in the same way; and, if not sufficiently perfect, it is then put in the place of the leading screw, and another screw cut from it by the same method, whereby any remaining errors are eliminated. A company has been formed for putting perfect screws on the market.

In the animated discussion which followed, President Sweet gave his experience in constructing the Cornell measuring-machine, and claimed that the nut should be made as long as the screw to avoid unequal wear of the latter. Among other opinions, it was claimed that scraping surfaces to a bearing is better than grinding; that tempered steel should be used, and other means devised for maintaining the screws perfect; and J. A. Brashear was referred to as having solved the problem of flat surfaces up to five inches diameter.

Mr. W. E. Kent of New York presented rules for conducting boiler-tests, in which the precautions necessary for determining the actual heating-power of a fuel, or the efficiency of a steam-boiler, were set forth at length. A committee was appointed to report upon a uniform method of making such tests. Mr. W. B. LeVan resumed his advocacy of quick transit in a paper, 'New York to Chicago in seventeen hours,' in which the time required for each of eight divisions was figured out, the average hourly mileage being fifty-five, whereas seventy to eighty miles is a common speed for short distances between Philadelphia and New York. A change in locomotive valve-motions was also recommended. Mr. Charles E. Emery read 'Estimates for steam-users,' in which he detailed the methods and formulæ in use by his company for arriving at the amount of steam furnished to various classes of customers. The New-York steam company has been selling steam at a fixed price since February, 1883.

Mr. H. R. Towne, of the Yale & Towne company, explained their drawing-office system, by which all

the operations of planning, making, lettering, dimensioning, altering, blue-printing, indexing, and preserving drawings, are reduced to a systematic procedure.

The remaining papers, for which, however, but little time remained, were: 'Cross-sectioning with the right-line pen,' J. B. Webb; 'Comparison of three modern types of indicators,' G. H. Barrus; 'A positive speed-indicator,' O. Smith; 'The experimental steel-works at Wyandotte,' W. F. Durfee; 'Early history of the steel-works at Troy,' R. W. Hunt; 'Experiments on non-conducting coverings for steam-pipes,' J. M. Ordway and C. J. H. Woodbury.

Professor Webb's paper referred to methods in use in his drawing-classes, with specimen of work.

Mr. Barrus gave the weights of the parts of the indicators, but neglected their moments of inertia: he compared the general appearance of the diagrams, and the correctness of the parallel motions: the errors of the springs were given, and the action of the drum mechanism discussed by means of an apparatus for detecting changes of phase. Some of these experiments seem to be in the right direction, but no discussion of underlying mechanical principles was attempted. Mr. Smith's machine is a counter for revolving shafts, *with a clock* which throws it in gear for one minute. The other papers will be read and discussed at the annual November meeting in New-York City.

Thursday was devoted to an excursion, by rail, up the Alleghany River for the purpose of visiting various works and furnaces. Among these were the Spang steel and iron company's works, the Isabella furnaces, the National soda-works, and the Plate-glass works, using natural gas as a fuel. A subscription dinner on Thursday evening, and a water excursion up the Monongahela on Friday, completed the programme of this meeting of the society.

DEVELOPMENT OF THE THYROID AND THYMUS GLANDS AND THE TONGUE.

UNDER the wide title of 'Ueber die derivate der embryonalen schlundbogen und schlundspalten bei säugethieren' (*Arch. mikr. anat.*, xxii. 271), G. Born discusses the development of these organs as determined by observations on pig embryos. These valuable researches give us, for the first time, an understanding of the morphology of the two glands of the above title, which have been a long-standing puzzle to comparative anatomists.

The tongue arises from the anterior part of the ventral floor of the pharynx. The space between the ventral ends of the first and second visceral arches is at first depressed; but later a longitudinal ridge grows up, separated on each side, by a groove, from the arches. The anterior portion of this ridge grows out, and becomes the free part of the tongue: the posterior part of the ridge projects between the third and fourth arches, and develops into the epiglottis. It will thus be evident that the tongue does not extend back beyond the second arch. After the embryo (pig) reaches a length of fifteen millimetres, the

tongue grows rapidly forward. (Although it has long been known that the tongue arises from the floor of the pharynx, the evident conclusion has not been sufficiently recognized, that the epithelial covering of the tongue is entodermal, and not ectodermal, and therefore not the same as the lining of the mouth, as a continuation of which the lingual epithelium is customarily described.)

The fate of the visceral clefts has been more fully elucidated than heretofore. The *first* becomes the outer and middle ear and the Eustachian tube, as is well known: the fate of the others has been obscure. According to Born, the *second* entirely disappears, becoming first a closed sac, and finally undergoing complete atrophy; the *third* likewise becomes a closed sac, which remains some time connected with the epidermis; from the inner end of the cleft arises a short caecum, extending ventrally inwards and forwards, which is the *anlage* of the thymus, and is retained and enlarged, while the rest of the cleft is atrophied; the *fourth* cleft also remains in part as a closed sac, which later joins in the formation of the thyroid gland.

The thymus was first shown by Kölliker (*Entwicklungsgeschichte*, 2te aufl.) to be an epithelial organ, and probably derived from a gill-cleft. Born traces its origin from the third cleft, as a ventral evagination near the inner opening. The caecum grows, at first, without altering its position or general appearance; but the rest of the cleft is reduced to a small canal, the outer part, indeed, to a solid cord of cells (embryo pigs of about sixteen millimetres). The whole, except the thymus portion, is atrophied, but the outer cords persist for a time. The thymus *anlage* spreads out into a canal, with walls of fine, many-layered epithelium. The lower end of the canal rests against the pericardium, where the aorta makes its exit. In embryos of two centimetres, the lumen of the canal has disappeared, and from the solid cord many branches have grown out, most abundantly at the heart end.

The thyroid gland, as was first shown by W. Müller (*Jenaische zeitschr.*, vi. 428, 1871), has a double origin. Born shows that the principal division arises as a median invagination in the floor of the pharynx, on a line with the front edge of the second visceral cleft. Very early this invagination separates from the pharyngeal epithelium, expands laterally chiefly, changes to a network, and at the same time moves backward until it comes to lie behind the glottis. Until the embryo is two centimetres long, the thyroid mass lies near the origin of the third aortic arch (common carotid); but in older embryos the division of the carotids has moved back, away from the head and the thyroid gland. The secondary portion of the thyroid is derived from the paired remnants of the fourth clefts. The median portion of the thyroid early changes into a network of epithelial cords. The outer cells of the cords are cylindrical: the inner cells, in several layers, are not very distinct from one another. Around the cords, the mesoderm forms sheaths of spindle cells, while between them the blood-vessels appear. The lateral *anlagen* become

somewhat pear-shaped, the large end lying ventrally. The lumen is retained until the fusion with the median part is accomplished by the union of the large end of the side components with the central division: the large end soon after assumes the characteristic net-like form of the thyroid gland; but the lateral portions can still be distinguished for some time by the lesser size of the meshes, and the greater size of the cords of the network into which they change.

In the introduction to his article, Born refers to the previous writings of Stieda and Wölfler, and closes with a criticism of the same, and other publications based upon his own researches. The most important point to be noticed is the correction of Wölfler's mistake in describing the second cleft as the first. (In this abstract, the author's arrangement of the matter has not been followed, as it appeared little conducive to clearness). C. S. MINOT.

RESEARCHES ON ASTRONOMICAL SPECTRUM-PHOTOGRAPHY.

At the time of his death, in November, 1882, Dr. Henry Draper had, for a number of years, been largely occupied with very tedious and costly investigations connected with the photography of the spectra of the heavenly bodies, his unusual adaptedness for the prosecution of which research conducted him to results of the highest importance. With true scientific spirit, Mrs. Draper has generously placed at the disposal of Professor Young and Professor Pickering all the data necessary for the proper publication of the work; and, in a monograph of about forty pages, the former gives an introduction to Dr. Draper's researches, together with a description of the apparatus with which they were made, extracts from the original note-books, and a list of the photographic plates in Mrs. Draper's possession; while the latter, who took a number of these plates to the observatory of Harvard college in the spring of 1883, presents the results of his measurements, accompanied by a discussion of the plates.

Dr. Draper's attention appears to have been first turned toward spectrum-photography in 1869 and 1870, although his photographic work in other fields previously to this time had been singularly successful. His first work in science, conducted while a medical student in New York, and which related to the function of the spleen, was illustrated with micro-photographs of great excellence; and very soon after taking his degree, while on a visit at Parsonstown, Ireland, he became so thoroughly impressed with the photographic possibilities of the great reflecting-telescope of the Earl of Rosse, that, soon after his return home, he began the construction of a metallic speculum of fifteen inches diameter, which was soon replaced by a number of silver-on-glass mirrors of about the same size, the details of the construction and mounting of which formed the subject of one of the Smithsonian contributions to knowledge, published in 1864. Seven years later, he had completed with his own hands the entire construction and mounting of a twenty-eight inch silvered-glass mirror, with

which he obtained, in May, 1872, his first photographs of the spectrum of α Lyrae by merely inserting a quartz prism in the path of the rays, just inside the focus of the small mirror, and employing neither slit nor lenses. Three months afterward, the same method secured for him plates showing four lines in the spectrum of the same star. For two or three years following, Dr. Draper's time was, for the most part, occupied with other lines of work, connected with investigations of the solar spectrum, and the superintendence of the photographic preparations for the transit of Venus of 1874. He returned to the subject of stellar spectra in 1876, obtaining a number of photographs with a fine twelve-inch refractor by Alvan Clark & Sons. This instrument, now the lesser telescope of the Lick observatory, was replaced in Dr. Draper's establishment, in 1880, by an eleven-inch Clark refractor, which was provided with a correcting-lens fitted to be placed in front of the object-glass to adapt it to photographic work. This instrument was mounted on the same set of axes with the twenty-eight inch Cassegrain mirror, as were also a finder of five inches aperture, and one of two inches,—all of which are well shown in the picture of the telescopes in the Hastings observatory, vol. i. of *Science*, p. 31.

Dr. Draper's eminent successes in celestial photography were due in large degree to his own skill and discoveries in the manipulation of the sensitized plates. Until 1879, wet collodion plates were used in all his experiments; but after that time he employed exclusively the dry plates made by Wratten & Wainwright, to the admirable performance of which, in the hands of Dr. Huggins, his attention was called by that distinguished astronomical physicist, on a visit of Dr. Draper to England in 1879.

Professor Young directs attention to the fact that the investigations of stellar spectra were by no means carried on continuously, but only during Dr. Draper's summer residence at his country-place, and in the intervals of other, to him, even more absorbingly interesting researches and urgent business occupations. The difficulties proved to be well-nigh insurmountable; for at first the limitations imposed upon the time of exposure by the use of the wet process made it almost impossible to get impressions of sufficient strength,—a difficulty which vanished on the introduction of the modern dry-plate processes: and another difficulty, increasing with the length of the exposure, was that of securing a sufficiently accurate movement of the driving-clock. No less than seven such clocks were constructed before he succeeded in getting a perfect one. Its regulator was a pair of heavy conical pendulums, so hung that their revolutions were sensibly isochronous through quite a range of inclination. The gearing and driving-screw were constructed, for the most part, by Dr. Draper himself, with the utmost care and accuracy; and Professor Young says, that, in its ultimate perfected condition, the driving-clock was as good as any in existence, being able to keep a star upon the slit for an hour at a time, when near the meridian, and not disturbed by changes of refraction.

And besides, the effect of changes of temperature upon the spectroscopic portion of his apparatus, and the difficulty of securing nights on which the atmosphere would not cut off the actinic rays to an unusual degree, not to mention the fact that the observatory was more than two miles distant from his residence, — these and many other conditions hindered the progress of the work. Spectrographic operations are, as Professor Young well says, much more sensitive to atmospheric conditions than are visual observations.

As regards the spectroscopic apparatus, a great many forms were employed, the first of which has already been mentioned. Later, direct-vision prisms were used in the same way, and spectroscopes made up of such prisms, some with a slit, some without, and some with a cylindrical lens to give necessary width to the spectrum. In the definitive arrangement of the apparatus, with which all the plates measured by Professor Pickering were made, a remodelled form of Browning's star-spectroscope formed the basis of the instrument; the telescope and collimator each having a focal length of six inches, and an aperture of 0.75 of an inch. The eye-piece and micrometer being removed, a block of hard wood was fitted on in such a way as to carry the photographic plate (a small piece of glass about an inch square); and a small positive eye-piece was mounted on the block, so that the yellow and red portions of the spectrum, projected beyond the sensitive plate into the field of view, could be examined at pleasure. It was thus possible to be sure that the driving-clock was running properly, and that all the adjustments remained correct. The whole apparatus weighed less than five pounds, and could be screwed on the eye-end of whichever telescope it was desirable to use it with. The development of the plates was usually by ferrous oxalate, though the alkaline development and pyrogallie acid were both used on some occasions. The pictures were about half an inch long, and one-sixteenth of an inch in width, extending from a point between the Fraunhofer lines *F* and *G* to a point near *M*.

Professor Pickering divides his work on these plates into three parts: first, the determination of the relative positions of the lines in the various spectra in terms of any convenient unit of length; second, from the known spectra of the moon and Jupiter, a determination of the relation of these measures to wave-lengths; third, a reduction of the measures of the stellar spectra to wave-lengths, and a discussion of the results. The stars whose spectra have been measured are α Aquilæ, α Lyrae, α Aurigæ, α Boötis, and α Scorpii. The spectrum of the first of these stars is remarkable for containing, in addition to the intense broad hydrogen-bands which characterize the spectrum of α Lyrae and similar stars, a multitude of very fine lines, which are easily seen between *G* and *H* in several of the plates, but are too delicate to be satisfactorily measured. Dr. Draper considered these fine lines very important as showing that Altair should be regarded as a sort of intermediate link between α Lyrae and Sirius on the one side, and Capella and the sun on the other.

On the plates of the spectra of α Aurigæ and α Boötis, not only do the lines appear to coincide in position with those of the sun, but their relative intensity seems to be nearly the same. Of the twelve lines seen in at least seven of the nine spectra of the moon and Jupiter, every one is contained in the spectra of both α Aurigæ and α Boötis. Of the fifteen lines which are so faint as to be contained in but one or two of the spectra of the moon or Jupiter, only four are contained in the spectrum of α Boötis, and but one in that of α Aurigæ. There is therefore no room for doubt of the correctness of Professor Pickering's conclusion that the evidence afforded by these photographs is very strong indication of the sameness of their constitution with that of our sun.

Professor Pickering's method of deriving his results from these plates is worthy of note here, as indicating the great degree of confidence to which they are entitled. To secure entire independence in the results, the measures were completed before the reductions were begun. The lines in each plate were measured without comparison with any map, and no search was made for lines which appeared to be wanting. When two similar spectra were photographed side by side, care was taken to cover one when measuring the other. Under these circumstances, the agreement in the measures of several plates is strong evidence of the identity of the spectra.

Appended to this monograph are three of the papers of Dr. Draper, reprinted from the *American journal of science*: 1°, On photographing the spectra of the stars and planets (December, 1879); 2°, On photographs of the spectrum of the nebula in Orion (May, 1882); and, 3°, Note on photographs of the spectrum of comet *b* 1881 (August, 1881). The first of these papers gives, in brief form, a very lucid statement of the conditions of the problem of celestial spectrum-photography, as well as the obstacles which he had, up to that time, overcome in solving it.

DAVID P. TODD.

THE GEOLOGY OF THE ASTURIAS AND GALICIA.

Recherches sur les terrains anciens des Asturies et de la Galice. Par CHARLES BARROIS, docteur ès-sciences. Lille, Six-Heremans, 1882. 630 p., 20 pl. 4°.

It was the good fortune of one of the writers of this review to see this work in process of evolution in the workshop and study of its hospitable author in Lille; but much as he admired the indomitable energy and patience which were presiding at its birth, as well as the copious notes and experience which were being assimilated into this monograph, the result is a surprise. How much more must it surprise those who are unacquainted with Dr. Barrois, to learn that he is but little past his thirtieth year; that this is but one of several important memoirs which he has begun and

completed alone; and that he has been able to do this while his chair in the faculty of science at Lille (Academy of Douai) was demanding the constant and fatiguing work of lectures and preparation, and his arduous labors in Brittany under the geological survey of France suffered no interruption!

Without the experience which he gained, both in the field and in the art of publishing, by his important and now often quoted "*Recherches sur le terrain cretacé supérieur de l'Angleterre et de l'Irlande*," which won him his doctorate from the University of France, he would hardly have been so successful in this last book. Both works begin with historical notices and bibliographies; but in the latest the first four pages are devoted to a veritable history of the labors of his predecessors, rather than to a mere list of their books. At the end of this, however, there are nearly four pages of titles rained upon the reader, as if Dr. Barrois were anxious to terminate this part, and get at his subject.

Accompanying this large and handsome quarto is an atlas in the same form, which contains twenty plates reproduced in the best style of art at the present day. The first three of these are colored plates, representing ten thin sections of rocks under the microscope and in polarized light. Each plate is conveniently covered by a thin tissue sheet containing the outlines of the constituent minerals, with the letters and figures necessary for identifying them. Following these are fourteen plates of fossils, of which four are from the hand of the author; nine were drawn by the lithographer, Mr. C. Rogghé; and one is a phototype from the *Ateliers de reproductions artistiques* in Paris. The last three plates are in order: one of vertical sections, one of section sketches, and one of pure sketches, on which latter interesting and important geological phenomena have been marked. Viewed as a whole, the artistic work is as perfect as any set of illustrations of scientific matter which the writer remembers to have seen. Where fault is so hard to find, he may be pardoned here for mentioning the only additions which it seems to him could have made the plates clearer; viz., a note of the amount of enlargement of the figures of plates ii. and iii., on the pages opposite those plates. Plate i. is thus provided.

The first part of the subject of this review (161 p.) is devoted to lithology. It is interesting and valuable, and will do much to increase the reputation of the author. It treats of the general and microscopic characters of the sedimentary rocks, including schists, phyllites, quartzites, limestones, and mimophyres; and

the crystalline massive rocks, comprising granite, quartz porphyry, diorite, diabase, and recent quartz-bearing kersantite. The schists are of every age, from the Cambrian to the carboniferous; and he divides their mineral ingredients into two classes,—those which were clastic, and prior in origin to the consolidation of the rocks; and those which were secondary, or crystallized out during the consolidation. The first class includes quartz, felspar, and white mica; the second, quartz, rutile, tourmaline, white mica, and chlorite. The term '*mimophyre*' is given by Barrois to a series of felspathic, porphyritic, and schistose rocks, which he thinks were formed from volcanic ashes and detritus,—the same as most porphyritic felsites are known to have been formed. The mimophyres are found associated with the sedimentary schists, quartzites, and phyllites, and belong to the Cambrian, Silurian, and Permian.

Of the plates, it is sufficient to state that they were made by Jacquemin, who prepared those for Messrs. Fouqué and Lévy's '*Minéralogie micrographique*.'

The second part treats of the paleontology of the Cambrian and Silurian (chap. i.), and of the Devonian and carboniferous (chap. ii.), and occupies 217 pages of very interesting matter; to which, however, it will be impossible here to make more than the briefest allusion. We learn from a prefatory note, that Dr. Barrois has succeeded in collecting three hundred and eighty-five species of fossils from the field of his labors in this part of Spain. Of these, thirty-nine are new species, which we owe to his research; viz., three in the Cambrian and Silurian, twenty in the Devonian, and sixteen in the carboniferous. The syllable '*Barr.*' affixed to many others, is apt to lead the hasty reader to ascribe these also to him; but the abbreviation is for Barrande, and not Barrois. The author's note (p. 177) on the right of precedence of Professor Haldeman's *Scolithus* over Ronault's *Tigillites* is a model of impartial justice and scholarly treatment of the subject.

Following the detailed description is a *résumé* (pp. 359 to 385) containing considerations by Dr. Barrois on the genera and species just referred to, with special regard to their parallelisms; and the chapter is concluded by speculations on the conditions under which the deposits have been formed. In the following chapter (ii.) the same method is applied to the fossils of the Devonian and carboniferous.

The third part is devoted to the stratigraphy, including, of course, the description of cross-sections. It is no fault of the author that this

portion of the work is more difficult to follow, owing to the necessity of subdividing the cross-sections, like the previous parts of the book, in accordance with the limits of the great formations. This difficulty is inherent in the case, and lies in deciding how to put the diverse phenomena before the mind in 'natural order' (much-abused phrase). If we follow the geographical divisions, there must be a continual interruption and resumption of the same geological horizon; whereas, if the geological boundaries are alone regarded, the geographical continuity is broken. Of the two solutions, perhaps the second is the better. The first of these subdivisions (chap. i.) is the 'primitive terrane' (used by de Castro to imply nearly what is meant by the archæan of Dana). It is very interesting in this connection (and not unexpected), to find that the upper division of the 'primitive' consists of the *roches vertes* which occupy this position in South Wales, the Appalachian belt, and in so many other places. They are mingled with chlorite schists and talc schists overlying the mica schists of Villalba, which latter contain biotite, muscovite, orthose, plagioclase, and two kinds of quartz; with garnet, zircon, sphene, and oligiste as accessories. Gneiss has been observed by Dr. Barrois only in subordinate thin layers intercalated among the mica schists.

The same is true of the garnetiferous amphibolites; but the difference between this Spanish stratigraphy, and that of those regions where similar rocks have been observed in America and in Europe, is, that the series in the former case are concordant. The Laurentian would appear, from Dr. Barrois' conclusions, to be wanting in the outcrops of Galicia, and the above-mentioned measures to represent a great development of the Huronian. The succession of Cambrian beds, both in the Asturias and in Galicia, he finds perfectly in accordance with Barrande's views of this part of Europe. From a fossil of *Archæocyathus* (Billings), characteristic of the Potsdam sandstone, found in the limestones of El Pedroso, MacPherson forms a column in which he thinks that possibly the Laurentian is represented at the base by mica and talc schists, with intercalated limestones of various colors, and sometimes filled with actinote (actinolite), and, more rarely, intercalated beds of felspathic grauwacke. On this rest argillaceous, splendid, siliceous talc schists, sometimes containing chialstolite; and on these, three benches of conglomerates, tuffs, and argillaceous schists and limestones, which he refers to the Potsdam sandstones.

Following this are details of the sections in

the Devonian and carboniferous. The sixth chapter treats of the phenomena which have modified the position of the paleozoic strata since these latter have been deposited. His conclusion is, that the Cantabrian Mountains owe their origin to two distinct lines of pressure; the one acting along east and west, and the other along north and south, lines. The former occurred between the carboniferous and Permian ages; and the latter, between the eocene and miocene.

The last subjects treated are the effects of denudation and the details of the actual surface-relief.

The work has been built on strong and sure foundations, and will long be cited as an authority. It is full of new facts and suggested analogies, and is characterized by thoughtfulness, industry, and modesty.

LOCKWOOD'S ELECTRICITY.

Electricity, magnetism, and electric telegraphy: a practical guide and handbook of general information for electrical students, operators, and inspectors. By THOMAS D. LOCKWOOD. New York, Van Nostrand, 1883. 377 p., illustr. 8°.

As indicated in its preface, Mr. Lockwood's unpretending book is not primarily intended for those having any considerable previous knowledge of the subject of electricity, but for the large number of persons who have not had the advantage of a scientific education, and yet find themselves in the employment of telegraph, telephone, or electric-light companies in various subordinate positions. To this class of persons the information contained in the work will doubtless be of great value; and, indeed, we do not recall any one book, of moderate size and price, in which so many of the different applications of electricity are considered in an elementary manner. To one familiar with the subject, the treatment of the more important topics must, of course, seem brief and occasionally superficial; but, recollecting the design of the work, it can hardly fail to win commendation, even from those who most clearly recognize its deficiencies.

The chapters on line-construction, office arrangements, and the adjustment and care of instruments, are excellent: and a very clear description of the principles of duplex and quadruplex telegraphy is given. There is also a good account of Mr. Gray's interesting harmonic multiple telegraph. Mr. Delany's ingenious multiplex synchronous telegraph is not described, probably because it did not

become well known until too late for insertion ; but we hope it may find a place in a future edition. The telephone has a chapter devoted to it. We wish that the theory of the instrument had been stated more at length, and are surprised to find not even a reference to the musical telephone of Reis.

The preceding remarks apply especially to the latter and technical portion of the book. The earlier chapters, which treat of various theoretical matters, are less worthy of praise. The definitions of electrical units are in some cases far from clear. Some of the remarks on p. 96, regarding the unit of capacity, are quite misleading. There are also some apparent slips of the pen. Such, for example, is the statement on p. 119, that the resistance of a battery increases in direct proportion to the number of cells, which is evidently true only when the cells are connected entirely in series. To the same origin we may probably trace the erroneous statement on p. 94, regarding the use of the terms 'weber' and 'weber per second.' The chapter on electrical measurements seems rather to be compiled from text-books than derived from the writer's knowledge of such experimentation, and hence fails to have the suggestiveness that is found in some portions of the book. The few pages devoted to electrotherapeutics are unworthy of the title, and do not deserve insertion in a separate chapter ; and more discrimination might well have been employed in the descriptions of the various electric lamps. The question-and-answer style is a disadvantage, which would be removed by the substitution of proper marginal titles.

A NEW CLASSIFICATION OF THE MOLLUSCA.

Encyclopaedia Britannica. 9th ed., vol. xvi., pp. 632-697. *Article, Mollusca*. By E. RAY LANKESTER.

As a rule, it is hardly in the ponderous tomes of an encyclopaedia that one looks for new, fresh, and breezy contributions to biology, or for epoch-making articles on biological topics. One rather expects the carefully weighed and sifted results of investigation which has already borne the test of publication and discussion, prepared for general comprehension by a divestment of all unnecessarily technical terms. In the present instance, whatever be the feelings of the layman who may refer to it, the scientific student of the Mollusca will be agreeably disappointed. It is rumored that the distinguished author has in preparation a manual of the invertebrates, of which it may be assumed

this article is the forerunner. For this reason, even in our limited space, which forbids a really thorough discussion of so large a topic, it is desirable that the attention of specialists should be called to it.

The school of which Professor Lankester is one of the leaders is marked by certain well-recognized features. They have broken away from the fetters of all previous zoölogical classification. Armed with the latest instruments and methods, they attack biological problems with ardor, and rarely fail to add materially to our knowledge, whatever be the subject treated. A new biology has arisen, and the gospel thereof is pedigree. By their ancestral trees shall ye know them, under whatever adult garb they may conceal themselves, — this is the new law of the new prophets.

So great a truth is contained in it, so rich the harvest under its stimulation, and so unanimously has it governed the generation first brought under its beneficial influence, that even yet to doubt its infallibility and ubiquity of application is to stigmatize one's self as a biological Philistine. Nevertheless, it is becoming pretty generally admitted that the relations of pedigree fail, in many cases, to express adequately the relations of adult animals as we find them in nature ; and that the genealogical stand-point, like any other single stand-point, taken by itself, is inadequate to the broadest and truest view.

Professor Lankester's work has the merits of his school in a very decided degree, while some of its faults are equally well marked. These we shall endeavor to point out, though limitation of space will compel us to do much less than justice to both.

"The Mollusca," he tells us, "form one of the great phyla or sub-kingdoms of the animal pedigree or kingdom." After a very slight sketch of the history of molluscan classification, the works of Woodward and Bronn are mentioned with deserved approval, the latter being termed "the most exhaustive survey of existing knowledge of a large division of the animal kingdom which has ever been produced ;" which would be true, if, for 'existing knowledge,' we were to read, 'knowledge existing twenty years ago.' Notwithstanding its great merits, the work of Bronn is now antiquated in many respects, as well as out of print, yet, so far, has found no worthy successor. If to the admirable and careful exposition of previous systematic work, characteristic of Bronn's monograph, Professor Lankester will join the biological results of the last twenty years, bringing both up to date, he will merit even higher

praise than that he has bestowed upon the German naturalist.

The plan of the work we are reviewing is excellent. In place of attempting a hard and fast definition of the molluscan phylum, he has described and figured an architypal mollusk in detail; and the reader, once familiarized with this type, can follow clearly the discussion of the subordinate branches. These are taken up seriatim, beginning with the more archaic forms. The phylum is divided by Lankester into two great branches,—the Glossophora and the Lipocephala. The first comprises three classes,—Gastropoda (in its widest sense); Scaphopoda, or the Dentalia; and Cephalopoda, with which the author includes not only the cuttles, etc., but the Pteropoda. The Lipocephala are equivalent to the Acephala of Cuvier, or the Lamellibranchiata of authors.

So far, the position of the Pteropoda (though not absolutely new) with the Cephalopoda, rather than as a class by themselves or as a subclass of Gastropoda, is the chief difference from the generally accepted classifications, and one which will be much criticised, if not finally rejected; since the little that is known of the embryology of the pteropods differs in important features from that of the cephalopods.

The Gastropoda are first discussed in a general way, and, on the whole, in a most satisfactory manner. We could wish, that, in introducing new Greek derivatives, some attention had been paid to euphony; for surely that melodious language can afford better terms than *gonad* ('sexual organ'), *osphradium* ('sensory organ'), *ctenidium* ('gill'), and others which grate upon the ear. We note among details the erroneous statement that the radula is horny (it is really chitinous), and that the jaws are usually calcified, and almost universally present. No single instance of a calcified jaw among recent Mollusca occurs to us, and there are large groups without a jaw. The jaw is composed of a substance allied to chitine, more or less combined with really horny material, the former defying alike the strongest acids and alkalis to reduce it.

The recognition of the radula as a feature of the highest systematic importance is very welcome: it is only to be regretted that the author seems to have fallen into utter confusion in his endeavors to indicate formulae for the teeth, and to have followed, without much investigation, the crude notions of Dr. Macdonald, rather than the researches of Troschel, Lovén, Woodward, or Sars. It seems also to have escaped him, that the radula is occasionally (though rarely) absent.

The author divides the Gastropoda into two subclasses, Isopleura and Anisopleura, characterized by the relations of the organs, which, in the former and more archaic group, are bilaterally symmetrical with a posterior anus: in the Anisopleura the visceral mass has been subjected to torsion, bringing the anus to the anterior right side, while the concomitant twisting of the remainder of the intestinal mass results in a masking of the original symmetry. In the process when originally brought about, if the termination of the intestine was sufficiently low, it became entangled in the pedal nervous loop, which, in following it, acquired a figure-of-eight form. If, on the other hand, the plane of intestinal torsion was above the pedal loop, the latter did not participate in the torsion, and in the succeeding generations retained its simple character. These relative features, observed by Spengel in a number of mollusks, are made, after him, the occasion of two super-ordinal groups,—Streptoneura and Euthyneura.

We regard the establishment of the subclasses above mentioned as a decided advance on previous systems, while it is doubtful if the super-orders will stand the test of future investigation. The character adopted as a basis is purely mechanical, and, so far as yet shown, without serious significance.

The isopleurous gastropods comprise the Chitons, Neomeniidae, and Chaetoderma, which are considered respectively as typifying orders. In our opinion, they should have been divided into two super-orders,—one the Polyplacophora, exhibiting a metameric repetition of the primitive shell-sac, and possessing a developed and functional foot; the other the Chaetodermitida, without (as adults) a primitive shell-sac or shell of any kind, and with the foot aborted, or rudimental. The statement (p. 641) that the cuticular spines of the latter group 'replace' the shell, is not correct in a strictly scientific sense, and the expression were better not used; for these spines are absolutely identical with the spines of the girdle in Chiton, and have no relation to the true shell.

The Anisopleura Streptoneura are divided into two orders, Zygo- and Azygo-branchia, accordingly as the suppression of the originally left-side organs is or is not carried out. These characters we regard as unsatisfactory, and the division resulting as artificial; Haliothis, Fissurella, etc., being combined with the true limpets, while their (to our notion) much nearer relatives, the Trochidae, Pleurotomariidae, etc., are left in the other order. Recent observations on the limpets indicate that this arrangement cannot be maintained, though we

have not space for a full statement of the case.

It should be said, that only examples of groups in classification as high as families appear in the work. Of about two hundred and seventy-five families of mollusks recognized by malacologists of later date than Bronn, about seventy only are referred to; and the genera assigned to some of these are not at present considered to be properly so placed. This, however, is a mere incident, which greater research into the present state of the science, outside the ranks of professional embryologists, will make it easy to rectify.

The Streptoneura comprise a large part of the ordinary marine gastropods bearing shells, but to them are added the heteropods. On the other hand, the Euthyneura comprise the nudibranchs, pulmonates, and opisthobranchs, — a not unnatural assemblage, but which should hardly be kept out where *Pyramidella*, *Entoconcha*, and *Phyllirhoë* are let in. We do not find any indication of the place of *Siphonaria* or *Gadinia*.

The *Solenococoncha* stand alone. That the *Pteropoda* should do so, rather than have been consolidated with the *Cephalopoda*, many will be disposed to believe, as Lankester admits that the development of the embryo 'presents no points of contact' between them.

In the *Lipocephala*, unfortunately, we have nothing new; and the old and now defunct orders based on the number of adductor muscles are retained.

The remarkable characters of the group of *Metarrhiptae* are not alluded to; and *Tridacna*, the type, is actually included in one family with *Dimya*, *Isocardia*, *Cyrena*, and *Cyprina*. In fact, the families of *Lipocephala* adopted are, in the light of modern investigations, too archaic for serious criticism.

We have noticed, in passing, some errors, and some features wherein we differ from our author in judgment on the facts presented. But we should do him grave injustice if we did not, before closing this review, give our testimony to the great value of his work.

In this paper is brought together the best summary of the results of recent anatomical and embryological research on the Mollusca. It is fully (though rather rudely) illustrated with fresh and well-selected figures. Several of the diagrammatic series given are extremely clear, satisfactory, and instructive. The article is a mine of information as to anatomy and development, digested and put in rational sequence. It is, however, a sketch, in broad outlines, of the developmental history of the

Mollusca, rather than a general treatise on the group. We hope that it, or an enlarged and improved treatise following on the same lines, may soon be accessible in better form for the student, whom it cannot fail to stimulate and instruct.

W. H. DALL.

ABORIGINAL LITERATURE OF AMERICA.

Aboriginal American authors and their productions, especially those in the native languages. By DANIEL G. BRINTON. Philadelphia, Brinton, 1883. 63 p. 8°.

The Güegüence: a comedy ballet in the Nahuatl-Spanish dialect of Nicaragua. Edited by D. G. BRINTON. Philadelphia, Brinton, 1883. 52+94 p. 8°.

THE first of these papers is an essay which grew out of a communication which Dr. Brinton made, in 1883, to the Copenhagen session of the *Congrès des Américanistes*. It is a bit of literary history, which groups, according to form of expression, — whether narrative, didactic, oratorical, poetic, or dramatic, — the various productions of the aborigines of America. It includes the writings in the native tongues of the Maya and Nahuatl races in the south. It embraces, also, the hot-bed literature of those tongues which have received their power of expression, in type, from the contact with the whites; as in the case, for instance, of the Cherokees. Nor are the efforts forgotten, of the training of those of Indian blood who have given expression both in the Latin, which was the common scholarly medium of the time of the Spanish conquest, and in the vernaculars which were acquired from the schools of the Spanish, French, and English settlers. This last phase extends the range pretty far beyond the scope of the linguistic interests attaching to the subject: but Dr. Brinton does not make it an essential part of his plan; and from his enumerations it clearly appears how much more receptive the nations which the Spaniards encountered were than the peoples of the north, brought to subjection by the French and English. The review which Dr. Brinton makes of the literary activity — if we may so call it — of all the American peoples, from the Eskimo southward, though but cursory, is a reasonably complete one, and opens a subject of great interest.

The second title is the third in a series of aboriginal American literature, which Dr. Brinton is giving opportunely to the students of the ethnological development of our indigenous races. In the present instance the

production is not purely Indian; for it is of comparatively recent origin, and represents the corruptions of both the Spanish and Aztec tongues, combined in a vulgar way. It is interesting, however, psychologically, and shows what humor and spirit can spring from the union of the races, which its jargon typifies. The text of the original is accompanied by a rendering into English; and in an introduction and notes, Dr. Brinton takes occasion, fortunately, to make record of a large amount of his curious and apposite learning.

M'ALPINE'S ZOÖLOGICAL ATLAS.

Zoölogical atlas (including comparative anatomy), with practical directions and explanatory text for the use of students. By D. M'ALPINE. 2 vols. New York, *The Century co.*, 1883. 16; 24 pl. f°.

THIS is a handsomely bound and finished work in two parts, dealing respectively with the invertebrates and vertebrates. It is intended as a guide to the student in the dissection of representative forms. The number of plates devoted to the different types is, however, hardly proportioned to their importance, much less to the commonness of their occurrence. Thus, four plates are assigned to Protozoa, and, of these, one and a half to the Monera. Perhaps so much space is given to these because the author knows that most students will never have the opportunity of studying the living forms. Yet this is hardly a sufficient excuse for crowding out altogether the Porifera and Coelenterata. Of these, not a single figure or diagram is given; although they are of universal occurrence, and far more important objects of study to the student than mere figures of Monera. The figures of Vermes are limited to those of the liver-fluke, tapeworm, and leech, all on one plate, while annelids are entirely neglected. At least one molluscoid, either a polyzoan or ascidian, might well have been added.

In his selection of vertebrates, the author has been far more fortunate; and he is to be especially commended for giving the anatomy of the salamander in place of that of the common, but unfortunately in many respects so abnormal, frog.

The drawings, unfortunately, leave the student in entire ignorance of the relative size of the different objects. Different organs and organic systems of the same animal are often drawn on a very different scale, and the student left to imagine that they are all alike, life-size, except that in marked cases the word 'enlarged' is added. The Protozoa are prodigious,

but whether magnified five hundred or five thousand diameters we are not informed. All this might very easily have been obviated by the use of a few figures or a simple scale.

Some mistakes in drawing or anatomy occur in each part. Thus the stone-canal of the starfish (plate v., diagram 1) is represented as connected directly with the top of one of the Polian vesicles. If any one will compare the other figures on this plate, especially Nos. 3 and 4, with the corresponding figures in Professor Brooks's 'Manual,' he will see immediately how the finer points of anatomy, especially of the haemal system, have been neglected. Fig. 3 is particularly unfortunate.

So, too, in plate xiii., figs. 4 and 5, the nervous system differs in the two drawings; and in fig. 5 the single parieto-splanchnic ganglion seems to be represented nearly midway between the anterior and posterior adductor muscles, but without name, and its name given to two siphonal (?) ganglia represented on the posterior adductor. One or two similar instances occur in the part devoted to vertebrates. Both in figures and notes, the author supports the theory of the development of an ovary and 'seminal capsule,' and the production of ova, in Paramoecium. This is certainly a bold position, in the face of such observations as those of Professor Bütschli on the conjugation of several species of the same genus, and described and supported by Professor Claus. But with few exceptions, and these, perhaps, more the fault of engraver than author, the anatomy seems generally correct.

The plates of the part on vertebrates are very fair and distinct; but in the figures of many of the smaller invertebrates the masses of color are far more noticeable than the correctness or clearness of the details. The internal anatomy of the crabs in plate viii. is so indefinite as to be of little assistance to a student. The figures in plate ix. are much clearer. All through both volumes, finer drawing and engraving, and a more judicious use of color, would have made a vast improvement. The engraving, particularly, is not so good as the price of the work would warrant; by no means so clear as in many text-books on zoölogy and comparative anatomy. The notes are usually good, though sometimes rather more literary than scientific. The description of the individual or species does not always emphasize the most important characteristics of the class which it illustrates, of the order or family to which it belongs.

The book would be a great help to any one wishing to take up a practical course of dissec-

tion without a teacher; but, for most students in such a situation, it is too expensive, while most of the teachers in advanced schools and colleges will prefer the finer plates of some of the foreign comparative anatomies, or the drawings to be found in the books of reference of the larger libraries. To teachers of zoölogy who have not such libraries at their command, or who, on account of ignorance of the language, are unable to use German text-books, the atlas would undoubtedly be a very great assistance.

NEW METEOROLOGICAL JOURNALS.

Meteorologische zeitschrift. Herausgegeben von der Deutschen meteorologischen gesellschaft. Redigirt von Dr. W. KÖPPEN. Heft i., January. Berlin, Asher, 1884. 8°.

American meteorological journal. Edited by Prof. M. W. HARRINGTON. Vol. i., no. 1, May. Detroit, Burr, 1884. 8°.

METEOROLOGY has received an impulse, both in Germany and America, by the almost simultaneous issue of a monthly meteorological journal in each of these countries. The two journals are intended, however, to cover different grounds, and so it will be necessary to state the position of each separately.

The *Meteorologische zeitschrift* has for its editor one of the greatest of living meteorologists, and it is intended to be a sort of co-laborer with the Austrian journal of meteorology. Much will be expected of this publication, and the first number leads us to believe that these expectations will be realized. In fact, but for the slight difference in appearance, one might think he was reading a number of its Austrian rival. We find such names as Neumayer, Zenker, Krankenhagen, Sprung, Van Bebber, and Köppen, appearing as contributors to this first number. Its first twenty-eight pages contain original communications, then come nine pages of correspondence and notices, then four pages concerning the founding of the society, followed by four pages of members of the German meteorological society, three pages of bibliography and book-notices, and two pages of plates. Although this January number is issued in April, yet the editor hopes to send out the successive numbers in such rapid succession, that after September they will appear at the proper time.

The American meteorological journal is edited by a professional astronomer, who has recognized the needs of American meteorologists, and is self-denying enough to offer his services for their benefit. From no journal of

this kind can one derive any pecuniary benefit; and it is the duty of meteorologists to help the editor, not only by communications, but also by subscriptions.

The matter of this first number of the journal is principally meteorological, and the topics treated are varied. The principal article is one on barometric waves of short period, and is by a well-known astronomer. In the early stages this journal will need the support of all astronomers and physicists who take an interest in meteorology, because we have not enough working meteorologists in this country to supply material enough to make the undertaking a success. Similar first steps taken in foreign countries have required this same aid.

Heretofore American contributions to our knowledge of meteorology have been scattered through various periodicals; but now they can be published together, and where they will be brought soonest to the notice of those interested. Although the editor will be forced to deal with the popular side of meteorology in order to make the journal readable to enough people to make the circulation large enough to pay the expenses, yet it is hoped that he will aim to make its scope as purely professional as possible. There are so many journals devoted to meteorology now, that one can only read the most important articles in each; and quality is of greater importance than quantity. The contents of this American journal are divided as follows: editorial notes; current notes; original communications; translations, etc., distributed over forty pages.

THE STUDY OF HEREDITY.

Life-history album, prepared by direction of the collegiate investigation committee of the British medical association. Edited by FRANCIS GALTON, F.R.S. London, Macmillan, 1884. 8+172 p., 8 pl. 4°.

Record of family faculties; consisting of tabular forms and directions for entering data, with an explanatory preface. By FRANCIS GALTON. London, Macmillan, 1884. 4+68 p. 4°.

WE have become accustomed to look for care and thoroughness in Mr. Galton's work, and it is pleasant to say that the two volumes before us fulfil our expectations. We can but assign to them an uncommon importance; for it is indeed significant, that the novel duty of recording the biological history of ourselves, our parents, and our children, is thus made easy to us by Mr. Galton. It is mainly to his influence that we must trace the conviction of thoughtful and earnest minds that it is really a duty to record the characteristics of every

individual and family; for Mr. Galton, more than any one else, has brought home to us the fact of our close dependence upon our ancestors for our traits of body, mind, and character. Mr. Galton's two small volumes provide most admirably for the facts in individual cases. The thicker of the two, the life-history album, will undoubtedly be the most widely used. It provides for the systematic record of the principal facts which may serve to indicate the constitutional character and the course of development of an individual from birth to seventy-five years of age. Directions, admirable in clearness and simplicity, are prefixed to the volume. The first of the blank tables that follow is for a brief genealogical record; the second, for the description of the child at birth. The remainder of the record is divided into five yearly periods. For each period the headings and blanks are repeated, so that the same qualities may be traced through all their changes. The data to be entered are of four kinds: first, physical characteristics, the stature, complexion, acuteness of the senses, etc.; second, other peculiarities, bodily endurance, recent trial of mental power, artistic capacity, resemblance to relatives; third, photographs in profile and full face; fourth, any other observations, including especially the full medical history. There are also charts on which to record graphically the growth; and these charts also give the curves of average growth for males and females. At the end of the volume are a few pages for records of the wife (or husband) and children. An appendix gives tests for vision.

Only those having experience can appreciate the study and thought which have been expended upon this remarkable album,—the product of a noble and wise philanthropy. Parents who earnestly desire their children's welfare will gradually learn to recognize the necessity of profiting by Mr. Galton's guidance in preserving a knowledge of their children's lives, for the plan which he has formulated can hardly be improved at present. Such knowledge is valuable to the child, not only as indicating its constitutional tendencies, but also often as giving warning of incipient disease, and as

revealing the influence of change in residence, occupation, diet, or habits, upon health. More valuable still will the accurately kept album be when the child becomes a parent.

"For mental and physical characteristics, as well as liabilities to disease, are all transmitted more or less by parents to their children. . . . The world is beginning to perceive that the life of each individual is in some real sense a prolongation of those of his ancestry. His character, his vigor, and his disease are principally theirs. . . . The life-histories of our relatives are, therefore, more instructive to us than those of strangers: they are especially able to forewarn and encourage us, for they are prophetic of our own futures."

The thinner volume is designed especially to further the science of heredity by gathering histories of families. It is arranged to contain brief records of the principal traits, bodily and psychic, of a person, and the person's parents, grand-parents, great-grand-parents, and children. Those who are able to do so, can render a valuable service, not only to themselves, but also to knowledge, by filling out accurately a record of their family faculties, and transmitting a duplicate to Mr. Galton, who will use it as a confidential document for statistical purposes only. That he will draw most valuable deductions from such materials, those who know his earlier researches are convinced beforehand. The album of family faculties has the same general plan and excellences, and deserves the same general praise, as the life-album.

Of the laws of heredity, but little is really known; but, when they are better and more generally understood, a great revolution must ensue in human society. Mr. Galton is laying the foundation of a thorough knowledge of heredity; and, because imagination hastens to conceive the future changes that may result, we are inclined to designate Mr. Galton's two recent publications as the most important books of the year. But in such matters, wisdom may be boldness in theory, but must be conservatism in practice: therefore let us diligently gather knowledge of heredity, and meanwhile postpone the anticipated revolution.

To all persons we earnestly recommend the faithful use of the two volumes we have reviewed.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

U. S. geological survey.

Fulgurite from Oregon.—During Mr. Diller's reconnaissance of the Cascade Range in the summer of

1883, Mr. E. E. Hayden collected from the summit of Mount Thielsen, one of the sharpest and most precipitous peaks in the Cascade south of the Columbia, specimens of fulgurite, the product resulting from the

fusion of rock-masses by lightning. The greater portion of Mr. Diller's time in April was devoted to the study of this rock, which was deemed worthy of special examination, not only on account of its rarity, but also from the fact that it presents the opportunity to study the products of an uncommon method of fusion. While the formation of fulgurite in sand is of frequent occurrence, it is only exceptionally produced in solid rock. The most important locality where it has been heretofore discovered in solid rock is Little Ararat in Armenia reported by Abich. Upon the specimen collected by him, Wichmann has made a brief microscopical research. An endeavor is being made to obtain some of the fulgurite of Little Ararat for comparison with the Oregon specimens.

Saussure mentions glazed hornblende schist as occurring on the summit of Mont Blanc; Humboldt reports fulgurite from one of the peaks in Mexico; Ramond saw it at several points in the Pyrenees and the Auvergne: but these occurrences have never been investigated.

Mr. Diller prepared a number of delicate, thin sections of the fulgurite from Mount Thielson; and its relation to the various constituents of the rock has been very clearly made out. A chemical analysis has been made by Prof. F. W. Clarke.

The material fused by the lightning was cooled so quickly that it all remained amorphous, and formed a dark, porous glass. In order to test the conclusions reached in the microscopical analysis, an attempt was made to crystallize the fulgurite. A completely amor-

phous fragment was heated without fusion in a Bunsen lamp for six hours, and then found, in polarized light, to be made up of strongly doubly refracting fibres, with a marked tendency to spherulitic arrangement. A finely pulverized portion was fused, and as highly heated as possible in a blast-lamp for four hours and three-quarters, and then allowed to cool gradually. Under the microscope, it was found that much of the felspar, some pyroxene, and many undeterminable microlites, crystallized out of the glass during the heating. The various stages in the development of felspar crystals from more or less regular groups of microlites, through lathe-shaped bundles of fibres to a completely clear, transparent crystal, are easily traced. The microscopical as well as the chemical evidence, and that derived from the re-crystallization of the fulgurite, all indicate that the fusion was confined chiefly to the siliceous groundmass of the rock with which the fulgurite is associated. The rhombic pyroxene was also fused to some extent, while the plagioclase felspar and olivine were not affected. The examination also indicates that the composition of the glass derived from the fusion of parts of a heterogeneous rock is a function of the fusibility and electric resistance of its various constituents.

The basaltic rock on which the fulgurite has been found is unique in the character of its pyroxene. The various mineral constituents of the rock are now being separated, for the purpose of a chemical analysis, by means of Thoulet's solution.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Brooklyn entomological society.

May 31. — Mr. Roberts gave an account of the habits of the Elmidae, a large number of which were collected by him at the Clifton excursion. — Mr. Schwensen called attention to the food-habits of some species of the Chrysomelidae, belonging or allied to *Cryptocephalus*. Many species are, in his experience, omnivorous; others, found only on certain groups of plants.

Academy of natural sciences, Philadelphia.

May 20. — Mr. Joseph Willcox stated, that, on the west coast of Florida, shell-mounds are very numerous, indicating the former favorite camping-grounds of Indians. The largest accumulation of shells is at Cedar Keys. A portion of the town is built on the mounds; and great quantities of the material, consisting almost entirely of oyster-shells, have been used in grading the streets. Human bones, stone implements, and fragments of pottery, are frequently found among the shells. Although Professor Wyman, in his memoir on Florida shell-heaps, asserts that stone chips are not common, being only found separately or a few together, and in no case indicating a place for the manufacture of arrow-heads or other implements,

such a place of manufacture may be seen on John's Island, at the mouth of the Cheeshowiska River. Several bushels of chips are here scattered about, all made of the chert rock, the only material in Florida suitable for the purpose. — Professor Heilprin, referring to the Foraminifera found in the rock-masses from Florida, stated, that, after a careful search, he had been able to add but one genus, *Spheroidina*, to those before enumerated. It was, he believed, the first time that any of the genera named at the meeting of April 22, except *Orbitoides*, had been discovered in America. He had also found another species of *Nummulites*, making, with *N. Willcoxii*, the second American form. The new species is twice the size of that named; and the septa are more numerous, and bent at a more acute angle. Two additional forms of *Orbitoides* had been determined, the presence of one of which, *O. ephippium*, places beyond doubt the oligocene age of the deposits containing it. — Mr. Thomas Meehan exhibited flowers of the remarkable *Halesia*, the striking variation in the leaves and seeds of which had formed the subject of a former communication. The flowers of the sport are cup-shaped instead of tubular; and the wide divergence reached without any intervening modifications was another illustration of the fact that the maxim of

Ray, '*Natura non facit saltum*,' needed modification. He had noticed that such departures usually occur in different parts of the country at the same time. The common calla lily, for instance, had, in several cases during the present season, developed a spathe some four inches below the perfect flower: in other words, the usually naked flower-scape of the *Richardia* had borne a bract. Flowers with a pair of more or less imperfect spathes were not uncommon in some seasons; the peculiarity of the cases now referred to being the interval of several inches on the stem, which justifies the application of the term 'bract' to the lower spathe. Numbers of such specimens had been brought to him from the neighborhood of Philadelphia, while others had been sent from Ohio, Indiana, and Illinois, hundreds of miles apart. In view of such circumstances, he believed that varieties might spring from widely separated centres by the operation of a general law entirely independent of environment. We know that distinct forms do spring through single individuals from seed, and that, after struggling successfully with all the vicissitudes of its surroundings, the new form may succeed in spreading, through the lapse of years or ages, over a considerable district of country. But the idea, that always and in all cases species have originated in this manner, presents occasionally difficulties which seem insurmountable. In the case of the similarity between the flora of Japan and that of the eastern portion of the United States, we have to assume the existence of a much closer connection between the land over what is now the Pacific Ocean, in comparatively modern times, in order to get a satisfactory idea of the departure of the species from one central spot, and to demand a great number of years for some plants to travel from one central birthplace before the land subsided; carrying back species in geological time farther, perhaps, than geological facts would allow. But if we can see our way to a belief that plants may change in a wide district simultaneously in one direction, and that these changes, once introduced, may be able to perpetuate themselves till a new birth-time should arrive, we have made a great advance towards simplifying the problem. — Mr. Edward Potts stated that a correspondent in Jamaica had failed to find there a single species of fresh-water sponge. It had been suggested that these organisms affect higher latitudes and elevated regions, — an opinion which the speaker was disposed to hold. In all the water-pipes examined by him, from the immediate vicinity of the basin, he had found abundant sponge-growth; and it had been asked if such growth might not be a cause of obstruction. In some sections of filled-up pipes, taken at a greater distance from the supply, he had found no sponge; the blocking substance being clay with iron impregnation. He had found, that, where masses of *Mayenia Leidyi* were strongly mixed in these pipes with iron, the skeleton spicules had undergone a curious change. In nearly all spicules, especially when young, a fine line can be traced down the middle; but, in the specimens referred to, a clear channel occupying two-thirds of the entire space, with openings at the ends, could be observed. It was suggested that the change

was due to the iron retarding the deposit of siliceous matter in the central channel of the spicules. In the birotulate spicules of the same masses the margins of the disk-like ends were eliminated, leaving them in the form of rays.

Davenport academy of natural sciences, Iowa.

May 30. — Mr. W. H. Pratt called attention to some interesting peculiarities in several of the flathead skulls from the Arkansas mounds, in one of which appears a large 'Inca bone,' formed by the presence of a horizontal occipital suture in addition to those usually present; and in another the ear-openings are nearly closed by the bones growing into them. He also exhibited a number of ossicles — minute bones of the internal structure of the ear — which had been extracted in cleaning out the earth which filled the cavities. — The honey-dew, which has been observed in such remarkable profusion this season, and the various opinions regarding its origin, came up for discussion; and twigs from several trees were presented for examination. The observations of several members seemed strongly to support the theory that the substance is, partly at least, produced by the bark-louse, *Pulvinaria innumerabilis*, and perhaps kindred species. This opinion was sustained by the following facts: 1°. It is found that the honey-dew is not deposited on the leaves at the top of the trees, hence is not an exudation from the leaf. 2°. It is not found on the white maples which are not infested by the bark-louse, several instances of which have been noticed. 3°. It is observed to a less extent on the box-elder tree; and on examination it is found that that tree is also infested by the *Pulvinaria*, though not so badly as the maple. 4°. It is observed that the honey-bee, which collects the honey-dew with great avidity, very often, and especially when the substance is considerably dried and hardened upon the leaves, proceeds directly to the under side of the limb, where the insects are fixed, and, running along the branch, examines them carefully, apparently seeking its supply from that source. 5°. It is also observed that there is always more or less of it upon the insects, especially in the morning; and, upon close examination, all are found to contain a quantity of the same substance. In view of these facts, the opinion was expressed, that, although further and thorough investigation is necessary to establish the fact, this will be the final solution, — that the honey-dew is largely the product of the *Pulvinaria*, the sap being by it extracted from the tree, and elaborated by the insect organism into this sweet substance, as is a similar or perhaps identical substance by some of the Aphides, and honey by the honey-bee.

Natural history society, Cornell university, Ithaca, N.Y.

May 29. — Mr. C. S. Prosser read a paper on silver in the Chemung and Catskill, the principal part of which was devoted to a consideration of the recently discovered silver-deposits near Oneonta, Otsego county, N.Y. It is claimed that valuable deposits of gold and silver have been found in the Catskill

or Chemung near Oneonta, and that, according to assays, the rock will yield per ton from fifty to a hundred and ninety-five dollars of gold and silver. In this paper the result of a series of assays was given, and no one indicated more than three dollars of silver to the ton of ore. There is in some of the rock a small amount of galena; and in this, from one to two ounces of silver in a ton of ore, but not any gold.

Society of arts, Massachusetts institute of technology.

May 8. — Prof. Edward C. Pickering addressed the society on the proper method of measuring colors. After referring to the difficulty of measuring color and in obtaining a proper unit for measurement, the speaker referred to the ordinary phenomena of color, and the effect of various bodies on the rays of light; dwelling, among other things, upon the effect of a large index of refraction in increasing the brilliancy of a body. The explanation was suggested, that the increased brilliancy of the so-called straw diamonds, so lately the subject of comment, and which were said to have been made of glass and painted, might have been due to a deposit upon them of a very thin layer of silver. The speaker said that the subject of color had generally been studied subjectively, that is, by its effect on the eye, and not objectively, as a phenomenon in itself. The generally accepted theory of color was explained, by which it is supposed that the eye can distinguish three primary colors, — red, green, and a bluish violet; and the objections to the use of Chevreul's color-circle as a means of measuring and distinguishing color were referred to. By the objective method of studying color, we may determine the intensity of each portion of the spectrum by a thermopile or bolometer, or by photography, or, again, by means of the instrument proposed by Vierordt, by which the lower half of the slit of a spectro-scope can be varied in width until any part of the corresponding spectrum shall be just equal in brightness to that coming from the upper half of the slit, through which is passed the light to be measured. The amount of opening of the lower half of the slit affords an invariable scale for the measurement of the relative intensity of two lights. Professor Pickering had experienced numerous difficulties in experimenting with Vierordt's instrument, especially when the lights differed greatly in intensity. The photo-spectroscope which he had finally perfected was exhibited and described. It consists of a spectro-scope with two slits, in which the relative intensities of two spectra may be measured by polarized light. Special devices were employed to render the images to be compared well defined on their edges, and of uniform brightness. The instrument allows of many practical applications in the measurement, by absolute standards, of paints, dyes, inks, glass, and the comparison of lights from various sources. Another application is to the measurement of the colors of stars, the chief difficulty being lack of light. In this measurement, Professor Pickering had modified the method of Professor Pritchard, who had compared the light of different stars by extinguishing them with a wedge of shade-glass, measuring by a scale

the point at which they ceased to be visible. Professor Pickering had measured the relative intensities of the different colors by spreading out the light of the star into a spectrum, and allowing the star to transit along the wedge, the time of disappearance of each color being noted. The exact color is determined by a series of slits. All the spectra are brought into the same position by an auxiliary image brought into the field by means of a plate of plain glass cemented to the side of the principal prism. The results given by this instrument are very encouraging, and promise to give a satisfactory measure of the intensity of each part of the spectrum of the stars.

Biological society, Washington.

May 3. — Dr. R. W. Shufeldt remarked in the course of his description of a pair of ribs on the occipital bone of the large-mouthed black bass, *Microp-terus salmoides*, that recently he had made a number of dissections of this fish, and in every instance had found a pair of ribs upon the occipital bone, just above and internal to the foramen of the vagus nerve (see *Science*, Nos. 65 and 69). They are without epi-pleural appendages, but otherwise like the abdominal ribs. If this fact be new to science, it is a very interesting discovery, of great morphological significance, and introduces an important factor in the theory of the segmentation of the skull. It had not been noticed in any of the prominent works upon comparative anatomy generally used as text-books, nor in a recent and very thorough article by Dr. Sagemehl upon the cranial osteology of *Amia caloa* (*Morph. jahrb.*, 1883). Dr. Shufeldt had also discovered these ribs thoroughly developed in the tunny, *Oreynus thynnus*, and thought that they would doubtless be found in others of the Scombridae and Centrarchidae. — Dr. T. Gill briefly reviewed the salient structural features of the various representatives of the order Squali, as well as the history of the classification of the group, and claimed that there were five principal types of structure manifested in the various forms, whose anatomy is more or less satisfactorily known: 1°, the Pternodonta, or Selachopichthyoidi, represented by but one known species, lately described by Mr. Garman (*Science*, No. 52); 2°, the Opistharthri, of which the Notidanidae or Hexarchidae are the only known forms; 3°, the Proarthri, of which the Heterodontidae, represented by the well-known 'Port Jackson shark,' forms the only existing family; 4°, the Anarthri, to which belong all living sharks excepting those now specifically eliminated; and, 5°, the Rhinae, to which belong the family Squatinidae, including the so-called 'angel-sharks.' The speaker was inclined to consider several of these more than sub-ordinal, and rather as of ordinal value; but, until they had been better studied, he would reserve opinion on this question. There was one type, represented by the extinct Cladodontidae, whose position was doubtful. For these he had formed the group *Lypospordyli*; but it was not evident whether it belongs with the true Squali, or whether it may not be related to the Holocephalus, the character of the branchial arches being dubious. — Mr. N. P.

Scudder exhibited specimens of muskrat skeletons, showing the number of the lumbar vertebrae to be six, and not three, as stated by Professor Flower. He also showed that the malar bone formed part of the continuity of the zygomatic arch; correcting the statement of Dr. Coues, in his 'Monograph of American Rodentia,' p. 253, with regard to the jugal of the muskrat, which is there described "as a mere splint, not forming by itself any part of the continuity of the arch, for the squamosal and maxillary spurs are absolutely in contact. This is a strong point of Fiber." Mr. Scudder remarked that muskrats were enabled to live from four to six minutes under water; owing, probably, to the enlargement of the abdominal *vena cava*, which extended over the abdominal aorta. He believed muskrats to be omnivorous, and said that the same individual could be taken repeatedly in the same trap.

May 17. — Dr. J. M. Flint gave a brief account of the history of medicine among the Chinese according to their own authors, and then discussed their theories in regard to the nature and causes of disease, and the action of remedies. Their ignorance of anatomy, and the consequent effects upon their theory and practice, were shown. The *materia medica* of the Chinese was then considered in detail, and its peculiarities, as well as its resemblances to our own present and past, as illustrated by the collection of Chinese drugs now in the possession of the National museum. — Mr. Wiley Britton sent a paper on the buffalo gnat of Tennessee, in which he stated that its habitat was confined to the Mississippi valley, below the mouth of the Ohio River. The flies generally make their appearance about the first of April, and remain from two to four weeks. They destroy annually more or less live-stock, particularly mules and horses; which, however, could be protected by thorough greasing. The bite of this gnat is poisonous, causing a swelling somewhat like a bee-sting. — Dr. T. H. Bean, in a paper on the white-fishes of North America, said there were twelve species indigenous to North America, besides the Inconnu, which is not properly a white-fish, though related to it. He made a few general remarks concerning the wide distribution, great abundance, and importance of the white-fishes as food, and stated the range of each species, its maximum size and weight, and its variations through age and conditions of habitat. A brief key to the species, intended to facilitate their speedy identification, and based upon natural characters only, was included in the paper. — Dr. Thomas Taylor exhibited a new instrument, a micrometer, of his own invention, for measuring accurately and instantly to the $\frac{1}{1000}$ inch the thickness of any object. He also explained that pseudo-bacteria were produced by the heating of blood at a comparatively low temperature, and proposed to make experiments for the purpose of deciding whether a continuous fever of four or five days, with the blood at 104°, would produce the same results as blood artificially heated to 110°. If so, it would account for mistakes that have been made by persons inexperienced in examining the blood of fever patients, who report the pres-

ence of bacteria when it was simply pseudo-bacteria, or broken blood-corpuscles, as shown by Beal and others. He further explained a method of throwing upon a screen the circulation of blood in a frog's foot, the magnification depending upon the distance of the reflecting object, using the high powers of the microscope on the principle of double sight.

NOTES AND NEWS.

ALONG the eastern verge of the Bahamas, somewhere in that skirmish-line of islands consisting of Cat, Watling's, Samana, Mariguana, and Turk's, Columbus made his landfall. Each has had its advocates; and the late Gustavus V. Fox, in 1880, in a report of the coast-survey, maintained the claim of Samana, which at that time was the only one possible, that had failed of an advocate. His arguments are now reviewed, and the whole question examined afresh, by Lieut. Murdoch of the navy, in a paper just printed in the proceedings of the U. S. naval institute. He claims for Watling's, which has had some strong supporters since it was first named by Muñoz in 1793. It is believed to be the landfall by Capt. Becher of the royal navy, who has printed the most considerable monograph on the subject; and such leading students of our earliest history as Major among the English, and Peschel among the Germans, have also been its advocates. The question is never likely, however, to be set at rest, unless contemporary documentary evidence, not now known, comes to light. We have nothing but Columbus's own journal to guide us, and a part of that only in abstract as Las Casas made it. No theory can satisfy all the conditions which it prescribes; and those which can be satisfied do not seem to pertain exclusively to any one point, as the variety of views clearly shows. Watling's may be said to receive the support of the greatest number of authoritative critics; and nothing more conclusive can be held to have been attained.

— In an article in the June *Century*, entitled 'What is a liberal education?' (noticed in an earlier part of this number), President Eliot of Harvard thus speaks of the place of natural science in a liberal scheme of study:—

The last subject for which I claim admission to the magic circle of the liberal arts is natural science. All the subjects which the sixteenth century decided were liberal, and all the subjects which I have heretofore discussed, are studied in books; but natural science is to be studied, not in books, but in things. The student of languages, letters, philosophy, mathematics, history, or political economy, reads books, or listens to the words of his teacher. The student of natural science scrutinizes, touches, weighs, measures, analyzes, dissects, and watches things: by these exercises his powers of observation and judgment are trained, and he acquires the precious habit of observing the appearances, transformations, and processes of nature; like the hunter and the artist, he has open eyes and an educated judgment in seeing; he is at home in some large tract of nature's

domain; finally, he acquires the scientific method of study in the field, where that method was originally perfected. In our day the spirit in which a true scholar will study Indian arrow-heads, cuneiform inscriptions, or reptile tracks in sandstone, is one and the same, although these objects belong respectively to three separate sciences, — archeology, philology, and paleontology. But what is this spirit? It is the patient, cautious, sincere, self-directing spirit of natural science. One of the best of living classical scholars, Professor Jebb of Glasgow, states this fact in the following forcible words: "The diffusion of that which is specially named science has at the same time spread abroad the only spirit in which any kind of knowledge can be prosecuted to a result of lasting intellectual value." Again: the arts built upon chemistry, physics, botany, zoölogy, and geology, are chief factors in the civilization of our time, and are growing in material and moral influence at a marvellous rate. Since the beginning of this century, they have wrought wonderful changes in the physical relation of man to the earth which he inhabits, in national demarcations, in industrial organization, in governmental functions, and in the modes of domestic life; and they will certainly do as much for the twentieth century as they have done for ours. They are not simply mechanical or material forces: they are also moral forces of great intensity. I maintain that the young science, which has already given to all sciences a new and better spirit and method, and to civilization new powers and resources of infinite range, deserves to be admitted with all possible honors to the circle of the liberal arts; and that a study fitted to train noble faculties, which are not trained by the studies now chiefly pursued in youth, ought to be admitted on terms of perfect equality to the academic curriculum.

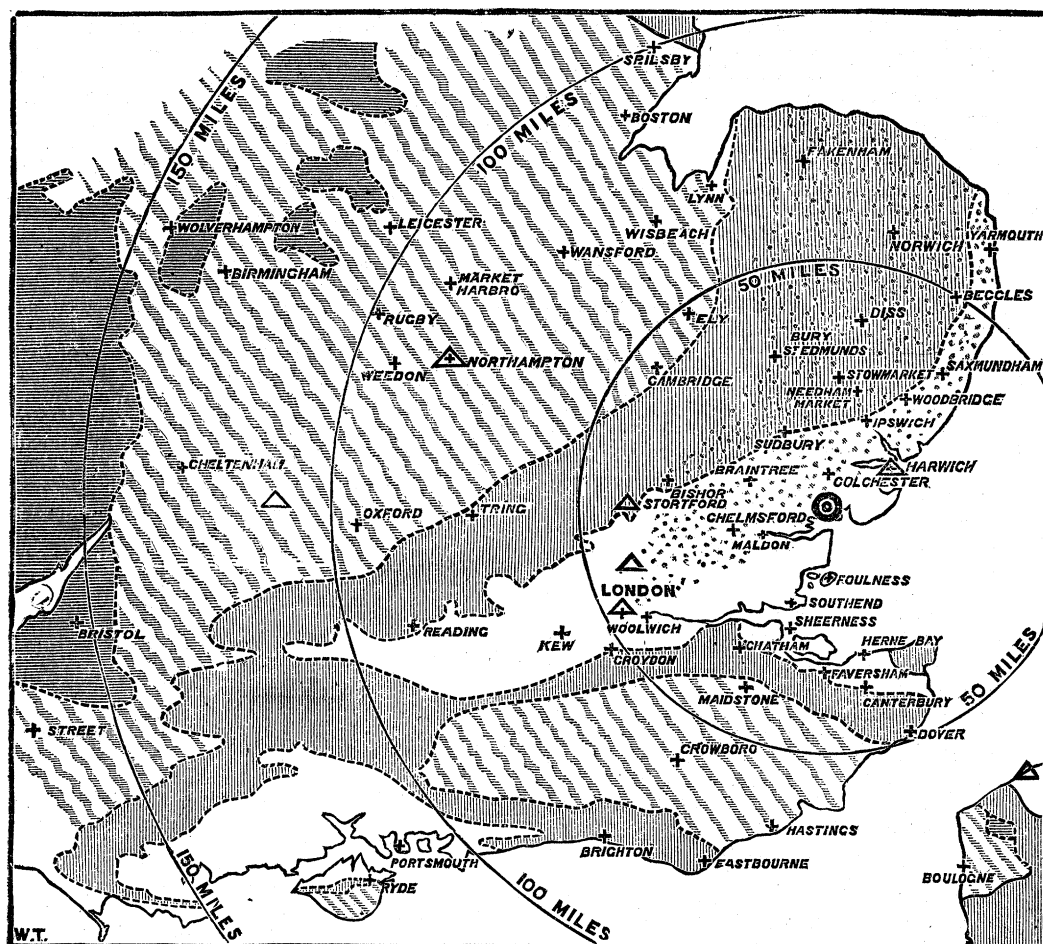
The wise men of the fifteenth century took the best intellectual and moral materials existing in their day, — namely, the classical literatures, metaphysics, mathematics, and systematic theology, — and made of them the substance of the education which they called liberal. When we take the best intellectual and moral materials of their day and of ours to make up the list of subjects worthy to rank as liberal, and to be studied for discipline, ought we to omit that natural science which in its outcome supplies some of the most important forces of modern civilization? We do omit it. I do not know a single preparatory school in this country in which natural science has an adequate place, or any approach to an adequate place, although some beginnings have lately been made. There is very little profit in studying natural science in a book, as if it were grammar or history; for nothing of the peculiar discipline which the proper study of science supplies can be obtained in that way, although some information on scientific subjects may be so acquired. In most colleges a little scientific information is offered to the student through lectures on the use of manuals, but no scientific training. The science is rarely introduced as early as the sophomore year: generally it begins only with the junior year, by which time the mind of the student

has become so set in the habits which the study of languages and mathematics engenders, that he finds great difficulty in grasping the scientific method. It seems to him absurd to perform experiments, or make dissections. Can he not read in a book, or see in a picture, what the results will be? The only way to prevent this disproportionate development of the young mind, on the side of linguistic and abstract reasoning, is to introduce into school courses of study a fair amount of training in sciences of observation. Over against four languages, the elements of mathematics, and the elements of history, there must be set some accurate study of things. Were other argument needed, I should find it in the great addition to the enjoyment of life which results from an early acquaintance and constant intimacy with the wonders and beauties of external nature. For boy and man this intimacy is a source of ever fresh delight.

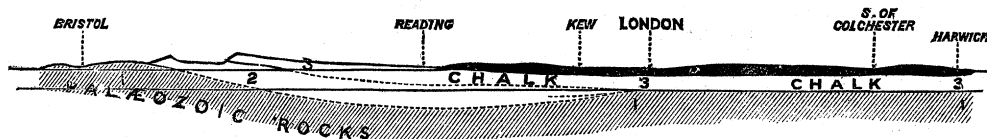
— Some questions having been raised in relation to the distance travelled by the Lapps of Baron Nordenskiöld's party in their excursion into central Greenland, Mr. Oscar Dickson arranged for a series of races on *skidor* ('snow-shoes') at Quickjock in Lapland. The distance which they claimed to have travelled over the Greenland ice was two hundred and thirty kilometres, going and returning in fifty-seven hours. For this reason the courses were arranged so as to have a total length of two hundred and twenty-seven kilometres. The races took place on the 3d of April last, and were spread over six days. The following results were obtained: —

The first prize, three hundred and fifty francs, was gained by Pavo Lars Tuorda, one of those who had visited Greenland with Nordenskiöld, and who travelled over the above-mentioned distance in twenty-one hours twenty-two minutes, including all stoppages. The second prize was gained by Pehr Olof Ländta, who came in half a minute later. The third and fourth prizes were awarded for the times of twenty-one hours thirty-three and a half minutes and twenty-one hours and fifty-six minutes respectively. Four others received a gratuity of thirty-five francs for having covered the distance in less than twenty-six hours. All arrived in good condition, unexhausted, and took part in the festivities which followed the races. Many of them had also travelled from seventy to a hundred kilometres before the race, to get to the point where the course began. It will be observed that the result completely confirms the claims of the Lapps on their journey in Greenland, as far as a parallel performance can do so.

— In an article in *Nature* of May 15, upon the recent earthquake in England, Mr. W. Topley gives a map of the affected district in which an attempt has been made to mark the positions of all places at which the shock was felt, so far as can be learned from published accounts; but in Essex, Suffolk, and North Kent, only a few of such places could be marked. By marking the outcrops of the older rocks (carboniferous and earlier), the possible connection of these with the travel of the earthquake-wave may be seen. This is made clearer by the section. The position of the



Map of the earthquake of April 22, 1884. N.B. — The places marked are those at which the shock was felt. In the east of England only the more important of such places are marked.



Section from Bristol to Harwich, showing the probable range of the paleozoic rocks. 1. Paleozoic rocks (carboniferous and older); 2. Permian to upper greensand; 3. Chalk.

paleozoic rocks is known at Harwich and London. There is some uncertainty as to their position under Reading and Colchester; but for the purpose intended, and regard being had to the depth at which the shock

must have originated (certainly far within the paleozoic rocks), the line drawn is sufficiently near the truth. We can see how the shock can have been propagated through the hard paleozoic rocks, and

been felt where these are bare or thinly covered with newer rocks; whereas, through the thick and softer secondary and tertiary rocks, the wave might travel a shorter distance. Possibly, also, this section may suggest an explanation of the double shock which was sometimes recorded: the first would be that travelling quickly through the hard paleozoic rocks; the second, that propagated more slowly through the softer overlying newer rocks.

—The Niger expedition, sent out by Dr. Emil Riebeck of Halle, is to devote itself especially to linguistic and ethnographical exploration; and the first report of its work has just appeared, under the title "Ein beitrage zur kenntniss der fulischen sprache in Africa, von Gottlob Adolf Krause," — an octavo pamphlet of a hundred and eight pages, with a map of the region explored, published by Brockhaus, Leipzig. The name of the people whose language Mr. Krause has studied is variously spelled. They call themselves in the singular, Pul; in the plural, Ful (the change of the initial consonant is in accordance with a euphonic law of the language); the French usually write the name Poul, and this form has been adopted by some English writers; but the Arabs and other neighbors more commonly employ the other: and it therefore seems better to call the people Fuls, and their language the Fulic. This people, spread over a large part of western and middle Sudan, with a territory about one-fourth as large as Europe, has been long recognized as one of the most interesting on the continent of Africa. They are clearly distinguishable, in physical and mental characteristics, from the negroes south and west of them, and are perhaps allied in degree of culture, and in language, to the Cushite tribes who dwell in and near Abyssinia. There are found among them both the brown-red type and the black. They are not massed in one community, but are settled in groups, with various occupations, — some peaceful and industrious, others warlike and predatory. Whence and when they came to their present abode is not known: their traditions are either not clear, or are evidently affected by their contact with the Arabs and other Mohammedans. But, from the few historical accounts which have been collected by European travellers, we learn that the Fuls have been a conquering people for centuries. The first reliable mention of them occurs in the thirteenth century of our era, at which time they had already established a kingdom. At the present time two Ful kingdoms are in existence, — that of Sokoto, and that of Gando; and their conquering career still continues. They have long since embraced Islam, are zealous students of the Kuran, and have begun to create a national literature. One of the most interesting facts in the history of the North-African peoples is the readiness and intelligence with which they have accepted Islam; and there is no doubt that they have been greatly benefited by its literary and ethical culture. The Fulic language has no distinction of genders (according to Gen. Faidherbe, it distinguishes human beings from the lower animals in its noun-termination), and no declension of nouns; but, on the other hand, it has a very elaborate devel-

opment of the verb. In this latter point, and in its pronominal forms, it seems to approach the Galla and other Cushic tongues, and even the Semitic. But these comparisons must be conducted very cautiously. The differences between the groups of languages in question are greater than their resemblances; and, if Semitic and Hamitic (that is, Egyptian, Libyan, and Cushic) ever formed one family, it was so long ago that the demonstration of their unity must be next to impossible. Mr. Krause compares some of the forms of these groups, and reaches the conclusion that the Fulic is to be regarded as proto-Hamitic; that is, as representing the original linguistic type from which Egyptian, Libyan (Berber), and Cushic have sprung: but this conclusion is not justified by the facts. Mr. Krause has done his work of exploration well; and it is to be hoped that he will be able to continue his investigations, and clear up some points in the Fulic language and history which are still obscure.

—*Nature*, May 29, states, that last autumn the expedition under Lieut. Holm for exploring the east coast of Greenland, and which is again to start northwards this spring, met a party of about sixty East-Greenlanders — men, women, and children — south of the island of Aluk, on the east coast. They were on the way to the west coast to sell bear, fox, and seal skins. Every attempt was made by the Danish explorer to induce some of them to return, and act as guides on his journey northwards; but the prospect of a visit to a Danish settlement proved too great. A considerable number of East-Greenlanders die on their way to the west coast. The East-Greenlanders are reported to differ much from the West-Greenlanders in stature and appearance; the men being often tall, with black beards and European cast of face. This seems to be particularly the case with those living far north. Both East and West Greenlanders have small hands and feet. During the year 1883, four boats with heathen East-Greenlanders arrived at Julianshaab. Three of these came from the distant Angmasalik; and in them there were also, for the first time, natives from Kelalualik, which is five days' journey farther north. The latter stated, that in the winter they were in the habit, when journeying on sleighs, of meeting with people living much farther north. Kelalualik being situated, it is believed, between latitude 67° and 68° north, it may be assumed that the whole line of coast from latitude 65° to 70° is to some degree populated.

—A note from Mr. Jurgens of the Lena international meteorological station says that the work there will terminate about the middle of June. The party will then proceed in boats to Yakutsk, where they hope to arrive in August. This letter, dated Nov. 13, says, that, during the summer of 1883, four hundred and fifty versts of routes in the Lena delta had been surveyed, and magnetic observations made at five different localities. The mean temperature of June, July, and August, was about 36° F. The Lena was closed by ice Sept. 19. During the summer the sky was constantly cloudy, with light winds accompanied by fog.

—The physical control of the character of sediments described by Rutot (see *Science*, 1883, ii. 560) is now considered by another Belgian geologist, Van den Broek, as the basis for a new style of classification of certain geological deposits; namely, for those fragmental strata, accumulated around the margin of oceanic areas, in which the alternation from coarse to fine sediments shows a variation in the depth of the water in which the accumulations were made. The work is an extension of the idea so well presented in Professor Newberry's 'Circles of deposition' some years ago.

—A meeting was held in Boston recently, at the rooms of the American academy of arts and sciences, to consider the advisability of forming a New-England society for observation and study of meteorology. Prof. W. H. Niles of the Massachusetts institute of technology was elected chairman, and Mr. W. M. Davis of Harvard college, secretary. After an informal discussion of the method and aims of such a society, a committee, consisting of Professor Winslow Upton of Brown university, Professor Arthur Searle of the Harvard college observatory, and Mr. Davis, was appointed to consider further plans for organization and work, and to report at a meeting to be called at an early date.

—*Cosmos les mondes* gives the following description of the Skrivanow pocket-battery. The element is constructed of sheet zinc and silver chloride wrapped in parchment paper, immersed in a solution of seventy-five parts of caustic potash, and a hundred of water. The whole is placed in a small trough of gutta-percha, which can be closed hermetically. The conductors and external contacts are of silver. Such an element, when complete, weighs about a hundred grams. Its electromotive force is 1.45 to 1.50 volt, and it yields for an hour a current of one ampère.

—Mr. Richard Jones, who has for many years devoted his attention to the preservation of meat, has now adopted a new process. The principle consists in the injection of a fluid preparation of boracic acid into the blood of the animal immediately after it has been stunned, and before its heart has ceased to beat; the whole operation, including the removal of the blood and chemical fluid from the body of the animal, only taking a few minutes. The quantity of boracic acid used is very small, and that little is almost immediately drawn out again with the blood. The preservation of the flesh is said to be thoroughly effected: the quantity of the chemical left in the flesh must therefore be very small, and can scarcely be injurious to the human system; for, as Professor Barff has proved by experiment, living animals, either of the human or other species, do not seem to be injured in any way by the consumption of it. A demonstration of the effects of the process was given in April at the Adelphi Hotel, when the joints cut from a sheep that had been hanging for more than seven weeks at the house of the Society of arts were cooked in various ways; and those present agreed that the meat was equal to ordinary butcher's meat.

—Mr. G. F. Kunz exhibited, at a recent meeting of the New-York academy of sciences, two ancient images of the llama and vicuna from the interior of Peru. They weighed six ounces each, and were both of solid silver, with the exception of the bodies, which were filled with some earthy material. The llama had evidently been acted upon by substances in the soil, which left the silver in a remarkably pure state; and the workmanship on this figure, especially the hair reproduction, was very fine. The vicuna is not of so pure silver, and is in a very good state of preservation. Mr. Kunz explained that a famine in the interior of the country had caused the graves to be despoiled of many thousand ounces of ornaments, which were carried to the seacoast, and there sold for their weight in silver and gold.

—It is said that a wild-flowers protection act has been introduced in the British house of commons, by the provisions of which any one, for twenty years to come, found grubbing up a fern, primrose, violet, or in fact any of the indigenous blossoms, shall be subject to fine and imprisonment. The inhabitants of Cornwall and Devonshire, those lands of fern, have been advertising largely their willingness to denude their own counties to supply the cities,—a process made easy by the parcel-post.

—The success of the late international exposition at Amsterdam has tempted the Colonial society of the Netherlands to propose the establishment of a periodical in French and Dutch, under the name of the *Revue coloniale et internationale*, in which those interested, of whatever nationality, can discuss with freedom any questions relating to colonial affairs. It is proposed to divide the contents into three sections, relating respectively to commerce and industry, government, and geography and ethnology. The support of geographers, in general, is requested toward the carrying-out of this programme.

—Some English tourists, including Mr. Graham of the Alpine club, have engaged two guides from the Bernese Oberland, and proceeded to India with the intention of scaling some of the high peaks of the Himalayas, especially Kabru (23,000 feet) and Zubanu (21,000 feet). For the present they will not attempt Mount Everest.

—We learn from *Nature*, May 29, that the French minister of education and the fine arts has proposed to place at the disposal of Pasteur, for the prosecution of his scientific experiments, a large domain situated at Villeneuve-Etang, which belongs to the state.

—Bove, after a short excursion on the Upper Parana, was to embark for the Falkland Islands and Tierra del Fuego. He expects to visit Italy this summer, and make preparations for an antarctic expedition projected for the year 1885.

—Widdeman, a French chemist, has observed that an insulating-skin can be produced on metal wires by decomposing plumbates and alkaline ferates with the electric current. The method is as follows: prepare a bath of plumbate of potash by dissolving ten grams of litharge in a litre of water, to which two hundred grams of caustic soda has been

added, and boil it during half an hour. Let it rest, decant, and the bath is ready for use. The wire to be covered with the insulating-skin is connected to the positive pole of the battery, and a small strip of platinum to the negative pole. Both wire and platinum are then plunged in the bath. Metallic lead in a very divided state is precipitated at the negative pole, and peroxide of lead on the wire. This layer of peroxide takes all colors of the spectrum, and the insulation is highest when the wire takes a brownish-black tint. If this insulator is durable, it will prove of great service in electric lighting.

— The Society of naturalists of the St. Petersburg university have decided on affording means to three zoölogists for expeditions in 1884. One is to study the fauna of the White Sea; another, the embryology and development of the genus *Accipenser* in the Ural River. The botanical and geological excursions will be discussed later on.

— On May 19 Pasteur read, at the Academy of sciences, his report on his four years' experimental studies on hydrophobia, and the means, not of eradicating, but of weakening it. The correspondent of the London *Daily news* describes Pasteur as "a man of square-built figure, and having the rather coarse and solid air which one so often finds in aristocrats and peasants in the Franche Comté, his native province. The eyes are so accustomed to the microscope as to have lost in great measure their normal capacity of visional adaptation, and are devoid of expression." Pasteur admits, in his report on hydrophobia, that the microbe causing it has not been discovered, though he is sure of its existence; and that it may become again rebellious after it has been transmitted to an organism more favorable to its growth. Thus the virus inoculated from an ass to a rabbit will not kill the latter, but if passed on to another rabbit, and then to dog or man, will be fatal. He observed that in some animals the virus lost, and in others gained, force. In the rabbit its power was most visible, whereas the ape was less terribly affected. It therefore occurred to Pasteur, that, if virus were transmitted from one ape to another, it would grow weaker at each inoculation. He took some from a dog's brain, and inoculated an ape, which died from its rabid virus. He inoculated a second, and then a third, which was hardly indisposed. The virus so modified was transmitted to a rabbit, in whose body it recovered some strength. It increased in morbid power in a second and third rabbit, and attained the maximum in the fourth. It would thus be seen that virulence was only kept in check by withholding from it good conditions for growth. It would be also seen that it never recovered, when well tamed, its pristine deadliness in a single bound. Pasteur claimed to so completely tame the virus, that a dog would, in being rendered refractory to rabies by hypodermic inoculation or trepanning, show no sign of illness. In the second part of his report, Pasteur explained how the maximum of virulence was certainly attained, by making several guinea-pigs the mediums between rabbits and dogs. He told the academy he had discovered a process by which he can operate with

diseased blood on healthy blood, and claims to be able to check the progress of rabies in freshly-bitten dogs or other animals. He asks the academy and the minister of public instruction to appoint a committee to study his proof experiments.

— One of the attractions of the London exhibition of hygiene is a street of old London, containing houses of various periods previous to the great fire of 1666, with the domestic arrangements of their time. Modern villa residences, as they ought to be, and as they ought not, also add to the interest of both tenant and landlord in what promises to be as great an attraction as the 'fisheries' was last year.

A correspondent of the New-York *Evening post* writes that the street representing old London was originally intended to be a life-like and life-sized model of Old Chepe, but it was found that no actual record of the locality remained. It was therefore decided to construct a street of celebrated and well-known relics, most of which have only disappeared within the last century. The work has been carried out under the superintendence of Mr. George Birch of the London and Middlesex archeological society. All the buildings belong to a period anterior to the great fire. One enters by Bishopsgate through a specimen of the old London wall: the arch is surmounted with the city arms, and a statue of Bishop William, the Norman. In the street we find the Rose inn, Fenchurch Street; the Cock tavern, Leadenhall; the Three squirrels, Fleet Street; Izaak Walton house, No. 120 Chancery Lane; and old shops from St. Ethelburga's Bishopsgate. The street is narrow, and the gables almost meet over one's head. A residence of the wealthy of that period is that of the Duc de Sully, also a house where Oliver Cromwell lodged in Westminster. There are examples of guild-halls, such as the Hall of the brotherhood, from Little Britain. Next we come upon the Old fountain hostelry from the Minories, — a quaint, tumble-down edifice of four stories, each projecting further over the other, and a lean-to gable roof. Whittington's palace is a fine specimen of the period. A full description of the show by the designers appears in the catalogue. There are specimens of all the Elizabethan types, as also of old Roman decoration in plaster and terra-cotta. The houses are peopled by figures dressed in the period from missals, old decorations, drawings, etc. Old armor, etc., has been lent, and the whole worked up into a most life-like show. The object is to give an idea of the hygienic condition under which our ancestors lived.

— The New-York *Evening post* states that the Spanish papers are full of the proposal to cut a canal from the Bay of Biscay to the Mediterranean Sea. The plan proposed is to deepen the River Gironde for some distance, and reach the open sea at Narbonne in the department of Aude. The proposed work will be about two hundred and fifty miles long, and will save a distance of nearly two thousand miles between Suez and London. Speaking of two great engineering proposals, one paper says that the channel tunnel will turn an island into a peninsula, while the new canal will turn a peninsula into an island.